

**CCNA**

Cisco Certified  
Network Associate

Lab Manual







# **CCNA**

(Cisco Certified Network Associate)

**Certification Mapped Course**

**Routing and Switching**

**Lab Manual**



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# Introduction

We are pleased to release the revised and updated lab manual for CCNA version 3. This lab manual is designed as a practical supplement to the concepts taught in the CCNA - version 3 mapped Routing and Switching course at Zoom Technologies India Pvt. Ltd.

We have lab exercises on all the topics covered in the CCNA-version 3 course. All the new topics have been given extensive coverage. This comprehensive manual will sufficiently prepare a student for the CCNA exam and more importantly equip him/ her with the right skills to design, install, maintain and troubleshoot WAN networks in the real world. We have also added a challenge lab at the end, to give the student a feel of the practical aspects of the CCNA exam.

Each of the exercises is divided into the five sections:

1. Objective
2. Topology
3. Tasks
4. Configuration
5. Verification

The lab manual leads the students from the basic initial configuration of a router to advanced topics like inter-vlan routing, OSPF- multi area configuration, EIGRP fine tuning, BGP configuration, password recovery, etc.

We hope that this lab manual would be helpful to the students in solidifying their foundation in WAN networking. Any feedback or suggestions to improve this would be gratefully accepted.







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| Verify IP SLA.....   | 242 |
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## EXERCISE 1: BINARY TO DECIMAL CONVERSION

| 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | ANSWER IN<br>DECIMAL | SCRATCH AREA |
|-----|----|----|----|---|---|---|---|----------------------|--------------|
| 1   | 0  | 0  | 1  | 0 | 0 | 1 | 0 |                      |              |
| 1   | 1  | 0  | 0  | 0 | 0 | 0 | 0 |                      |              |
| 1   | 0  | 1  | 0  | 1 | 0 | 0 | 0 |                      |              |
| 0   | 1  | 0  | 0  | 0 | 0 | 0 | 0 |                      |              |
| 0   | 0  | 0  | 0  | 1 | 0 | 1 | 0 |                      |              |

## EXERCISE 2: DECIMAL TO BINARY CONVERSION

| DECIMAL | ANSWER IN BINARY |    |    |    |   |   |   |   | SCRATCH AREA |
|---------|------------------|----|----|----|---|---|---|---|--------------|
|         | 128              | 64 | 32 | 16 | 8 | 4 | 2 | 1 |              |
| 167     |                  |    |    |    |   |   |   |   |              |
| 63      |                  |    |    |    |   |   |   |   |              |
| 17      |                  |    |    |    |   |   |   |   |              |
| 24      |                  |    |    |    |   |   |   |   |              |
| 254     |                  |    |    |    |   |   |   |   |              |



**EXERCISE 3: ADDRESS CLASS IDENTIFICATION**

| ADDRESS        | CLASS |
|----------------|-------|
| 126.10.1.1     |       |
| 128.10.1.1     |       |
| 162.78.1.10    |       |
| 39.255.255.255 |       |
| 220.1.1.10     |       |

## EXERCISE 4: NETWORK AND HOST IDENTIFICATION BASED ON CLASS OF ADDRESS

| CIRCLE THE NETWORK PORTION<br>OF BELOW ADDRESSES | CIRCLE THE HOST PORTION<br>OF BELOW ADDRESSES |
|--|---|
| 132.12.1.1                                       | 161.43.5.6                                    |
| 128.10.1.1                                       | 13.1.100.254                                  |
| 176.13.10.10                                     | 202.153.32.121                                |
| 162.78.1.10                                      | 100.140.2.230                                 |
| 200.1.1.1  | 171.24.100.10                                 |



**EXERCISE 5: DEFAULT SUBNET MASK**

| ADDRESS        | CLASS |
|----------------|-------|
| 126.10.1.1     |       |
| 128.10.1.1     |       |
| 162.78.1.10    |       |
| 52.255.255.255 |       |
| 220.1.1.10     |       |

## EXERCISE 6: NETWORK ADDRESS

USING THE IP ADDRESS AND SUBNET MASK SHOWN, WRITE THE NETWORK ADDRESS

| IP ADDRESS AND SUBNET MASK  | NETWORK ADDRESS |
|-----------------------------|-----------------|
| 121.12.1.1<br>255.0.0.0     |                 |
| 175.13.10.10<br>255.255.0.0 |                 |
| 200.1.10.1<br>255.255.255.0 |                 |
| 119.0.255.20<br>255.0.0.0   |                 |
| 191.168.1.10<br>255.255.0.0 |                 |



## EXERCISE 7: BROADCAST ADDRESS

USING THE IP ADDRESS AND SUBNET MASK SHOWN, WRITE THE BROADCAST ADDRESS

| IP ADDRESS AND SUBNET MASK      | BROADCAST ADDRESS |
|---------------------------------|-------------------|
| 161.43.5.6<br>255.255.0.0       |                   |
| 13.1.100.254<br>255.0.0.0       |                   |
| 202.153.32.121<br>255.255.255.0 |                   |
| 100.140.2.230<br>255.0.0.0      |                   |
| 171.24.100.10<br>255.255.0.0    |                   |

## EXERCISE 8: CISCO SLASH NOTATION

| SLASH NOTATION | SUBNET MASK |
|----------------|-------------|
| /29            |             |
| /22            |             |
| /12            |             |
| /25            |             |
| /18            |             |



## EXERCISE 9: BINARY TO HEXA DECIMAL CONVERSION

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ANSWER IN<br>HEXADECIMAL |  |
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--------------------------|--|
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |                          |  |
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## EXERCISE 10: HEXADECIMAL TO BINARY CONVERSION

| HEXADECIMAL |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| E           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 9           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2F          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4FD         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 01E8        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2001        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| FE80        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |



## EXERCISE 11: OMISSION OF ZERO'S

| IPv6 ADDRESS                            | IPv6 ADDRESS<br>AFTER OMISSION OF ZERO'S |
|---|--|
|   |  |
|   |  |
| 2001:2222:0000:0000:0000:0000:0000:0001 |  |
| 20DB:C0A8:0101:0000:0000:0000:0000:0042 |  |
| 2000:0000:0000:4DAD:0023:0046:00BB:0101 |  |
| FF02:0000:0000:0000:0000:0000:0000:0001 |  |
| 0000:0000:0000:0000:0000:0000:0000:0001 |  |

## EXERCISE 12: REPLACING SUCCESSIVE FIELDS OF ZERO'S WITH "::"

| IPv6 ADDRESS                              | IPv6 ADDRESS  |
|---|---|
|   | AFTER REPLACING SUCCESSIVE FIELDS OF ZERO'S WITH "::" |
| 2002:1111:04CF:0000:0000:0000:0000:002F   |   |
| 3FFF:0000:0000:0000:0000:005D: 0000:09CE  |   |
| 2001:0000:0000: FACE: B00C:0000:0000:0069 |   |
| 20DB:0000:0000:6666:0000:0000:0000:5228   |   |
| 2001:1111:0000:0000:0000:0000:0000:0001   |   |

## EXERCISE 13: CUSTOM SUBNET MASK (SUBNETTING)

| PROBLEM : 1                                   |             |
|---|-------------|
| Number of needed subnets                      | 14          |
| Network Address                               | 200.10.10.0 |
| Address class                                 |             |
| Default subnet mask                           |             |
| Custom subnet mask                            |             |
| Total number of subnets                       |             |
| Total number of host addresses                |             |
| Number of usable addresses                    |             |
| Number of bits borrowed from the host portion |             |



### PROBLEM : 2

|   |            |
|---|------------|
| Number of needed usable hosts                 | 60         |
| Network Address                               | 171.10.0.0 |
| Address class                                 |            |
| Default subnet mask                           |            |
| Custom subnet mask                            |            |
| Total number of subnets                       |            |
| Total number of host addresses                |            |
| Number of usable addresses                    |            |
| Number of bits borrowed from the host portion |            |

### PROBLEM : 3

|   |               |
|---|---------------|
| Network Address                               | 138.25.0.0/26 |
| Address class                                 |               |
| Default subnet mask                           |               |
| Custom subnet mask                            |               |
| Total number of subnets                       |               |
| Total number of host addresses                |               |
| Number of usable addresses                    |               |
| Number of bits borrowed from the host portion |               |

### PROBLEM : 4

|   |           |
|---|-----------|
| Number of needed subnets                      | 2000      |
| Network Address                               | 111.0.0.0 |
| Address class                                 |           |
| Default subnet mask                           |           |
| Custom subnet mask                            |           |
| Total number of subnets                       |           |
| Total number of host addresses                |           |
| Number of usable addresses                    |           |
| Number of bits borrowed from the host portion |           |



### PROBLEM : 5

|   |            |
|---|------------|
| Number of needed usable hosts                 | 1000       |
| Network Address                               | 165.34.0.0 |
| Address class                                 |            |
| Default subnet mask                           |            |
| Custom subnet mask                            |            |
| Total number of subnets                       |            |
| Total number of host addresses                |            |
| Number of usable addresses                    |            |
| Number of bits borrowed from the host portion |            |

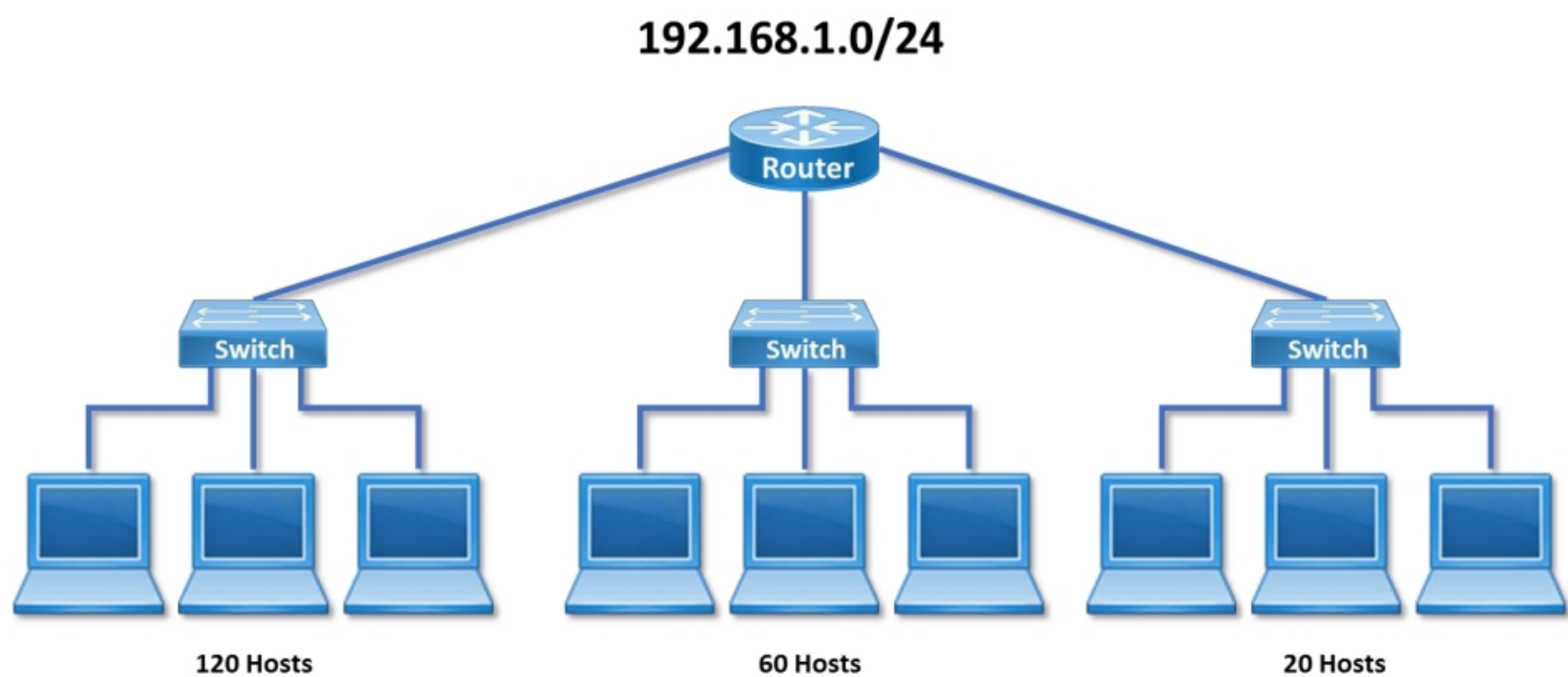
### PROBLEM : 6

|   |                |
|---|----------------|
| Network Address                               | 192.100.1.0/29 |
| Address class                                 |                |
| Default subnet mask                           |                |
| Custom subnet mask                            |                |
| Total number of subnets                       |                |
| Total number of host addresses                |                |
| Number of usable addresses                    |                |
| Number of bits borrowed from the host portion |                |

## EXERCISE 14: VARIABLE LENGTH SUBNET MASK (VLSM)

### PROBLEM: 1

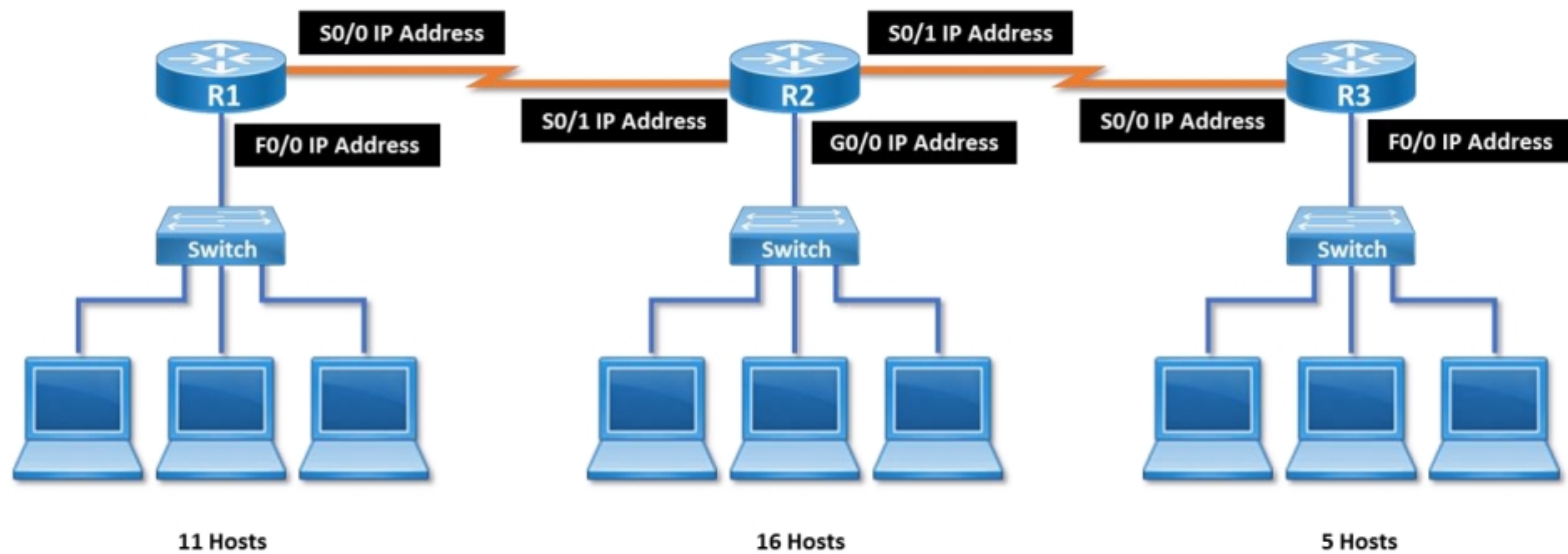
The administrator gave the networking team 192.168.1.0/24 to use for addressing the entire network. After subnetting the address, the team is ready to assign the addresses





## PROBLEM: 2

The administrator gave the networking team 192.168.164.0/24 to use for addressing the entire network. After subnetting the address, the team is ready to assign the addresses. The administrator plans to configure ip subnet-zero and use RIP v2 as the routing protocol. As a member of the networking team, you must address the network and at the same time conserve unused addresses for future growth.



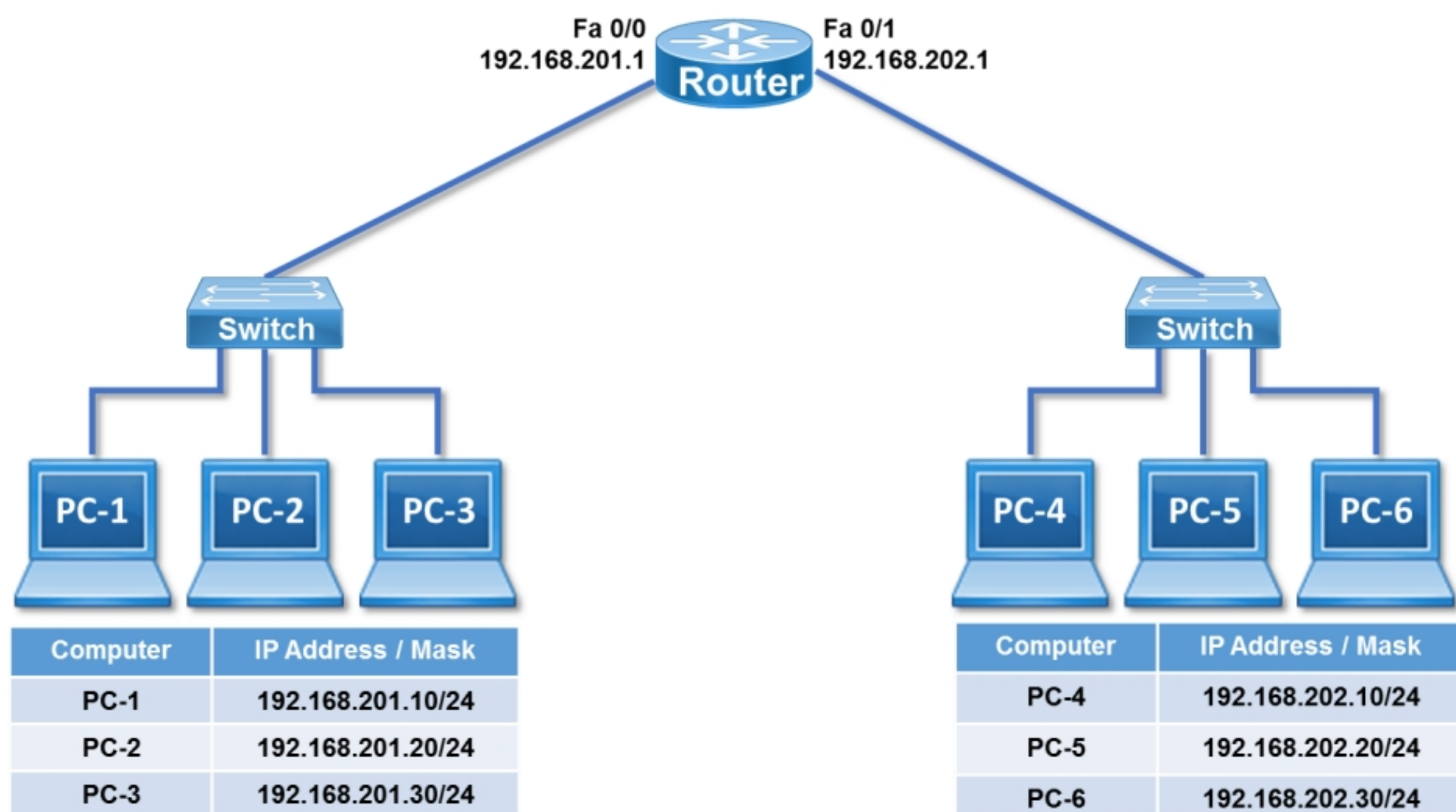
## LAB 1: UNDERSTANDING IPv4 NETWORK COMMUNICATION

### OBJECTIVE:

To verify communication between same network and different network computers after assigning IPv4 Address and Default Gateway.

### TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



### TASK:

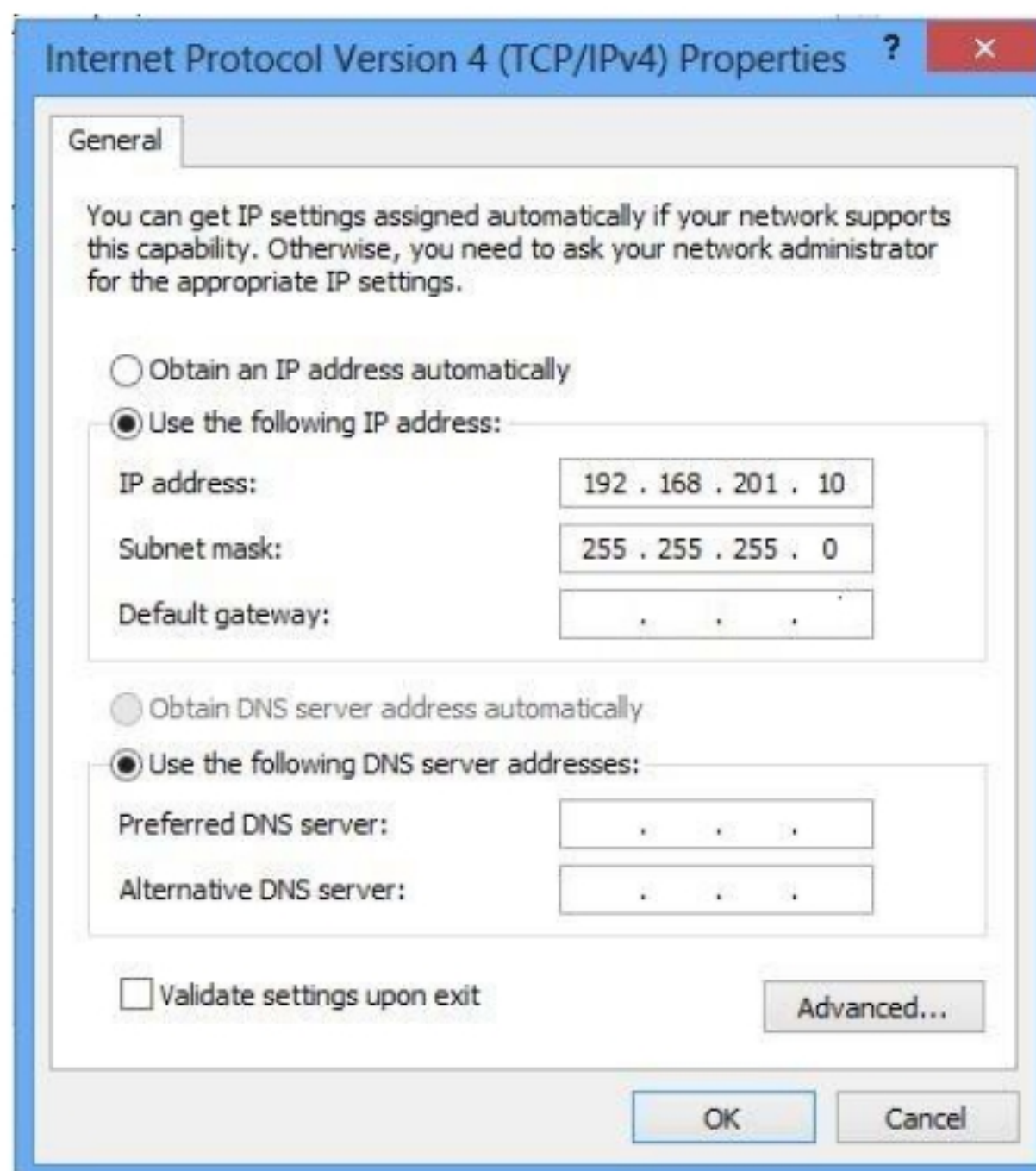
- Assigning IPv4 address to computers.
- Verify communication between the same and different network computers.
- Assigning Default Gateway address to computers.
- Verify communication between the different network computers.



## Assigning IPv4 Address to computers

### On Windows 7 or Windows 8.x or Windows 10 Computer

- Open **Network and Sharing Center**
- Click on **Change adapter settings** and Click **Open**.
- **Right-click** on your local adapter and select **Properties**.
- In the **Local Area Connection Properties** window select **Internet Protocol Version 4 (TCP/IPv4)** then click the **Properties** button.
- Now select the radio button **Use the following IP address** and enter in the IP address and Subnet mask and click **OK**.



- Verify above configured ip address by giving below command.

C:\> **ipconfig**

Windows IP Configuration

Ethernet adapter Ethernet:

Connection-specific DNS Suffix . :

IPv4 Address. . . . . : 192.168.201.10

Subnet Mask . . . . . : 255.255.255.0

Default Gateway . . . . . :

- Repeat the above steps to configure ip address on all windows based computers.



## On Linux

- Give below command to configure ip address

```
bt ~ # ifconfig eth0 192.168.201.10
```

- To verify the configured ip address by giving below command.

```
bt ~ # ifconfig
eth0      Link encap:Ethernet  HWaddr 00:21:97:73:58:21
          inet addr:192.168.201.10  Bcast:192.168.201.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:171979 errors:0 dropped:0 overruns:0 frame:0
          TX packets:341932 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:12370727 (11.7 MiB)  TX bytes:463457462 (441.9 MiB)
          Interrupt:20 Base address:0xe800

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:18 errors:0 dropped:0 overruns:0 frame:0
          TX packets:18 errors:0 dropped:0 overruns:0 carrier:0
          RX bytes:1796 (1.7 KiB)  TX bytes:1796 (1.7 KiB)
```

- Repeat the above steps to configure ip address on all linux based computers.

## Verify communication between the same and different network computers.

### From 192.168.201.10 computer (i.e. PC1) ping other computers

#### **ping 192.168.201.20**

```
PING 192.168.201.20 (192.168.201.20) 56(84) bytes of data.
64 bytes from 192.168.201.20: icmp_seq=1 ttl=64 time=24.0 ms
64 bytes from 192.168.201.20: icmp_seq=2 ttl=64 time=24.0 ms
64 bytes from 192.168.201.20: icmp_seq=3 ttl=64 time=24.1 ms
64 bytes from 192.168.201.20: icmp_seq=4 ttl=64 time=24.0 ms
```

#### **ping 192.168.201.30**

```
PING 192.168.201.30 (192.168.201.30) 56(84) bytes of data.
64 bytes from 192.168.201.30: icmp_seq=1 ttl=64 time=24.0 ms
64 bytes from 192.168.201.30: icmp_seq=2 ttl=64 time=24.0 ms
64 bytes from 192.168.201.30: icmp_seq=3 ttl=64 time=24.1 ms
64 bytes from 192.168.201.30: icmp_seq=4 ttl=64 time=24.0 ms
```

#### **ping 192.168.202.10**

```
connect: Network is unreachable
```

**From 192.168.202.10 computer (i.e. PC4) ping other computers****ping 192.168.202.20**

PING 192.168.202.20 (192.168.202.20) 56(84) bytes of data.  
64 bytes from 192.168.202.20: icmp\_seq=1 ttl=64 time=24.0 ms  
64 bytes from 192.168.202.20: icmp\_seq=2 ttl=64 time=24.0 ms  
64 bytes from 192.168.202.20: icmp\_seq=3 ttl=64 time=24.1 ms  
64 bytes from 192.168.202.20: icmp\_seq=4 ttl=64 time=24.0 ms

**ping 192.168.202.30**

PING 192.168.202.30 (192.168.202.30) 56(84) bytes of data.  
64 bytes from 192.168.202.30: icmp\_seq=1 ttl=64 time=24.0 ms  
64 bytes from 192.168.202.30: icmp\_seq=2 ttl=64 time=24.0 ms  
64 bytes from 192.168.202.30: icmp\_seq=3 ttl=64 time=24.1 ms  
64 bytes from 192.168.202.30: icmp\_seq=4 ttl=64 time=24.0 ms

**ping 192.168.201.10**

connect: Network is unreachable

**From 192.168.201.10 computer (i.e. PC1) trace network communication path to other computers**

**tracert 192.168.201.20 (Windows) or traceroute 192.168.201.20 (Linux)**  
traceroute to 192.168.201.20 (192.168.201.20), 30 hops max, 38 byte packets  
1 192.168.201.20 (192.168.201.20) 1.456 ms 0.193 ms 0.114 ms

**tracert 192.168.201.30 (Windows) or traceroute 192.168.201.30 (Linux)**  
traceroute to 192.168.201.30 (192.168.201.30), 30 hops max, 38 byte packets  
1 192.168.201.30 (192.168.201.30) 1.156 ms 0.193 ms 0.114 ms

**From 192.168.202.10 computer (i.e. PC4) trace network communication path to other computers**

**tracert 192.168.202.20 (Windows) or traceroute 192.168.202.20 (Linux)**  
traceroute to 192.168.202.20 (192.168.202.20), 30 hops max, 38 byte packets  
1 192.168.202.20 (192.168.202.20) 1.456 ms 0.193 ms 0.114 ms

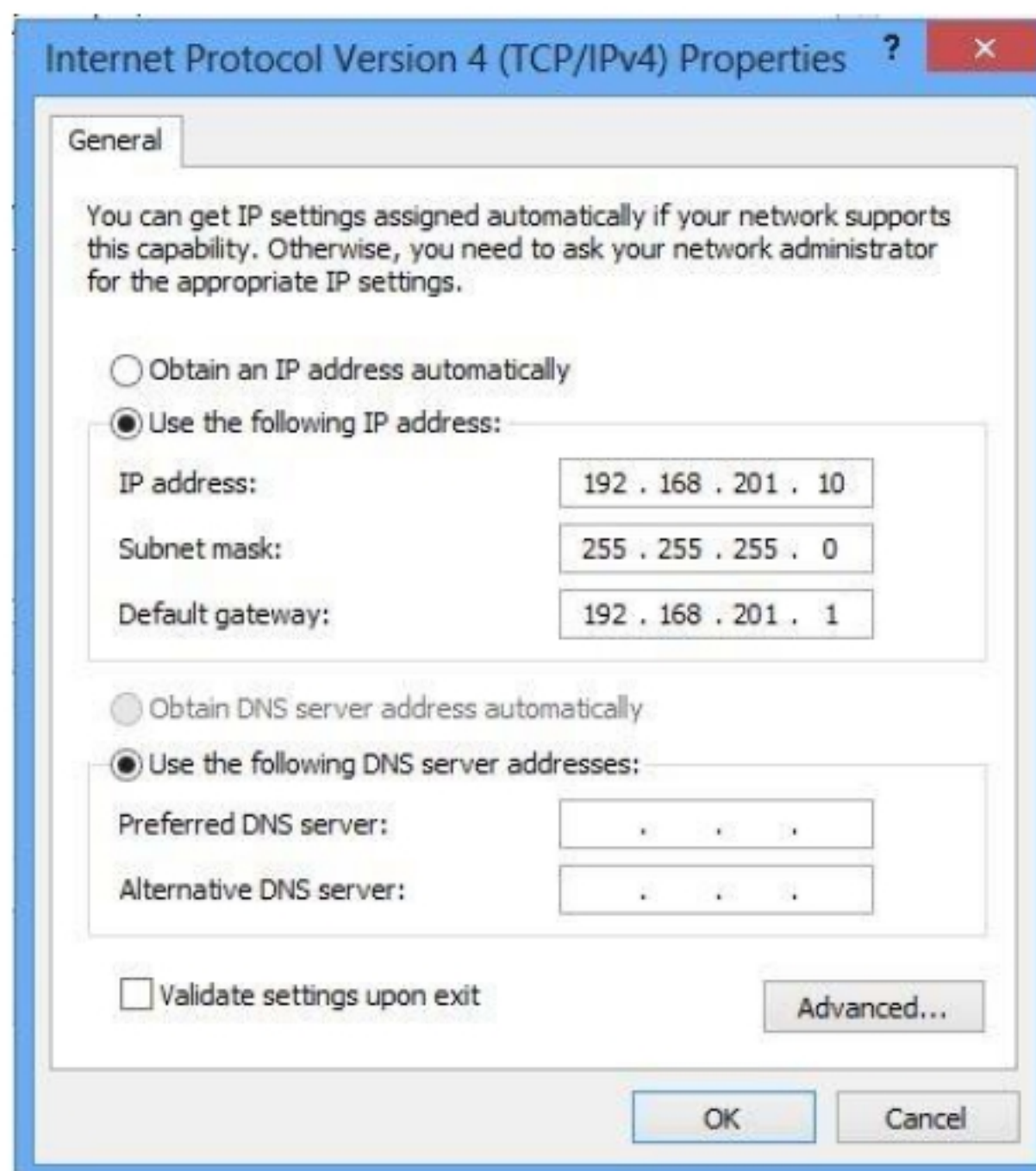
**tracert 192.168.202.30 (Windows) or traceroute 192.168.202.30 (Linux)**  
traceroute to 192.168.202.30 (192.168.202.30), 30 hops max, 38 byte packets  
1 192.168.202.30 (192.168.202.30) 1.156 ms 0.193 ms 0.114 ms



## Assigning Default Gateway address to computers

### On Windows 7 or Windows 8.x or Windows 10 Computer

- Open **Network and Sharing Center**
- Click on **Change adapter settings** and Click **Open**.
- **Right-click** on your local adapter and select **Properties**.
- In the **Local Area Connection Properties** window select **Internet Protocol Version 4 (TCP/IPv4)** then click the **Properties** button.
- Now select the radio button **Use the following IP address** and enter **Default Gateway** and click **OK**.



- Verify above configured default gateway by giving below command.

C:\> **ipconfig**

Windows IP Configuration

Ethernet adapter Ethernet:

Connection-specific DNS Suffix . :

IPv4 Address. . . . . : 192.168.201.10

Subnet Mask . . . . . : 255.255.255.0

Default Gateway . . . . . : 192.168.201.1

- Repeat the above steps to configure default gateway on all windows based computers.



## On Linux

- Give below command to configure default gateway

```
bt ~ # route add default gw 192.168.201.1
```

- To verify the configure default gateway by giving below command.

```
bt ~ # route -n
Kernel IP routing table
Destination      Gateway          Genmask          Flags Metric Ref    Use Iface
192.168.201.0    0.0.0.0         255.255.255.0    U        0      0      0 eth0
127.0.0.0        0.0.0.0         255.0.0.0        U        0      0      0 lo
0.0.0.0          192.168.201.1   0.0.0.0          UG       0      0      0 eth0
```

- Repeat the above steps to configure default gateway on all linux based computers.

## Verify communication between the different network computers.

### From 192.168.201.10 computer (i.e. PC1) ping other computers

#### **ping 192.168.202.10**

```
PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.
64 bytes from 192.168.202.10: icmp_seq=1 ttl=63 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=2 ttl=63 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=3 ttl=63 time=24.1 ms
64 bytes from 192.168.202.10: icmp_seq=4 ttl=63 time=24.0 ms
```

#### **ping 192.168.202.20**

```
PING 192.168.202.20 (192.168.202.20) 56(84) bytes of data.
64 bytes from 192.168.202.20: icmp_seq=1 ttl=63 time=24.0 ms
64 bytes from 192.168.202.20: icmp_seq=2 ttl=63 time=24.0 ms
64 bytes from 192.168.202.20: icmp_seq=3 ttl=63 time=24.1 ms
64 bytes from 192.168.202.20: icmp_seq=4 ttl=63 time=24.0 ms
```

#### **ping 192.168.201.30**

```
PING 192.168.202.30 (192.168.202.30) 56(84) bytes of data.
64 bytes from 192.168.202.30: icmp_seq=1 ttl=63 time=24.0 ms
64 bytes from 192.168.202.30: icmp_seq=2 ttl=63 time=24.0 ms
64 bytes from 192.168.202.30: icmp_seq=3 ttl=63 time=24.1 ms
64 bytes from 192.168.202.30: icmp_seq=4 ttl=63 time=24.0 ms
```



**From 192.168.202.10 computer (i.e. PC4) ping other computers****ping 192.168.201.10**

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.  
64 bytes from 192.168.201.10: icmp\_seq=1 ttl=63 time=24.0 ms  
64 bytes from 192.168.201.10: icmp\_seq=2 ttl=63 time=24.0 ms  
64 bytes from 192.168.201.10: icmp\_seq=3 ttl=63 time=24.1 ms  
64 bytes from 192.168.201.10: icmp\_seq=4 ttl=63 time=24.0 ms

**ping 192.168.201.20**

PING 192.168.201.20 (192.168.201.20) 56(84) bytes of data.  
64 bytes from 192.168.201.20: icmp\_seq=1 ttl=63 time=24.0 ms  
64 bytes from 192.168.201.20: icmp\_seq=2 ttl=63 time=24.0 ms  
64 bytes from 192.168.201.20: icmp\_seq=3 ttl=63 time=24.1 ms  
64 bytes from 192.168.201.20: icmp\_seq=4 ttl=63 time=24.0 ms

**ping 192.168.201.30**

PING 192.168.201.30 (192.168.201.30) 56(84) bytes of data.  
64 bytes from 192.168.201.30: icmp\_seq=1 ttl=63 time=24.0 ms  
64 bytes from 192.168.201.30: icmp\_seq=2 ttl=63 time=24.0 ms  
64 bytes from 192.168.201.30: icmp\_seq=3 ttl=63 time=24.1 ms  
64 bytes from 192.168.201.30: icmp\_seq=4 ttl=63 time=24.0 ms

**From 192.168.201.10 computer (i.e. PC1) trace network communication path to other computers****tracert 192.168.202.10 (Windows) or traceroute 192.168.202.10 (Linux)**

traceroute to 192.168.202.10 (192.168.202.10), 30 hops max, 38 byte packets  
1 192.168.201.1 (192.168.201.1) 1.086 ms 1.124 ms 1.144 ms  
2 192.168.202.10 (192.168.202.10) 2.295 ms 2.156 ms 2.209 ms

**tracert 192.168.202.20 (Windows) or traceroute 192.168.202.20 (Linux)**

traceroute to 192.168.202.20 (192.168.202.20), 30 hops max, 38 byte packets  
1 192.168.201.1 (192.168.201.1) 1.086 ms 1.124 ms 1.144 ms  
2 192.168.202.20 (192.168.202.20) 2.295 ms 2.156 ms 2.209 ms

**From 192.168.202.10 computer (i.e. PC4) trace network communication path to other computers****tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)**

traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets  
1 192.168.202.1 (192.168.202.1) 1.086 ms 1.124 ms 1.144 ms  
2 192.168.201.10 (192.168.201.10) 2.295 ms 2.156 ms 2.209 ms

**tracert 192.168.201.20 (Windows) or traceroute 192.168.201.20 (Linux)**

traceroute to 192.168.201.20 (192.168.201.20), 30 hops max, 38 byte packets  
1 192.168.202.1 (192.168.202.1) 1.086 ms 1.124 ms 1.144 ms  
2 192.168.201.20 (192.168.201.20) 2.295 ms 2.156 ms 2.209 ms

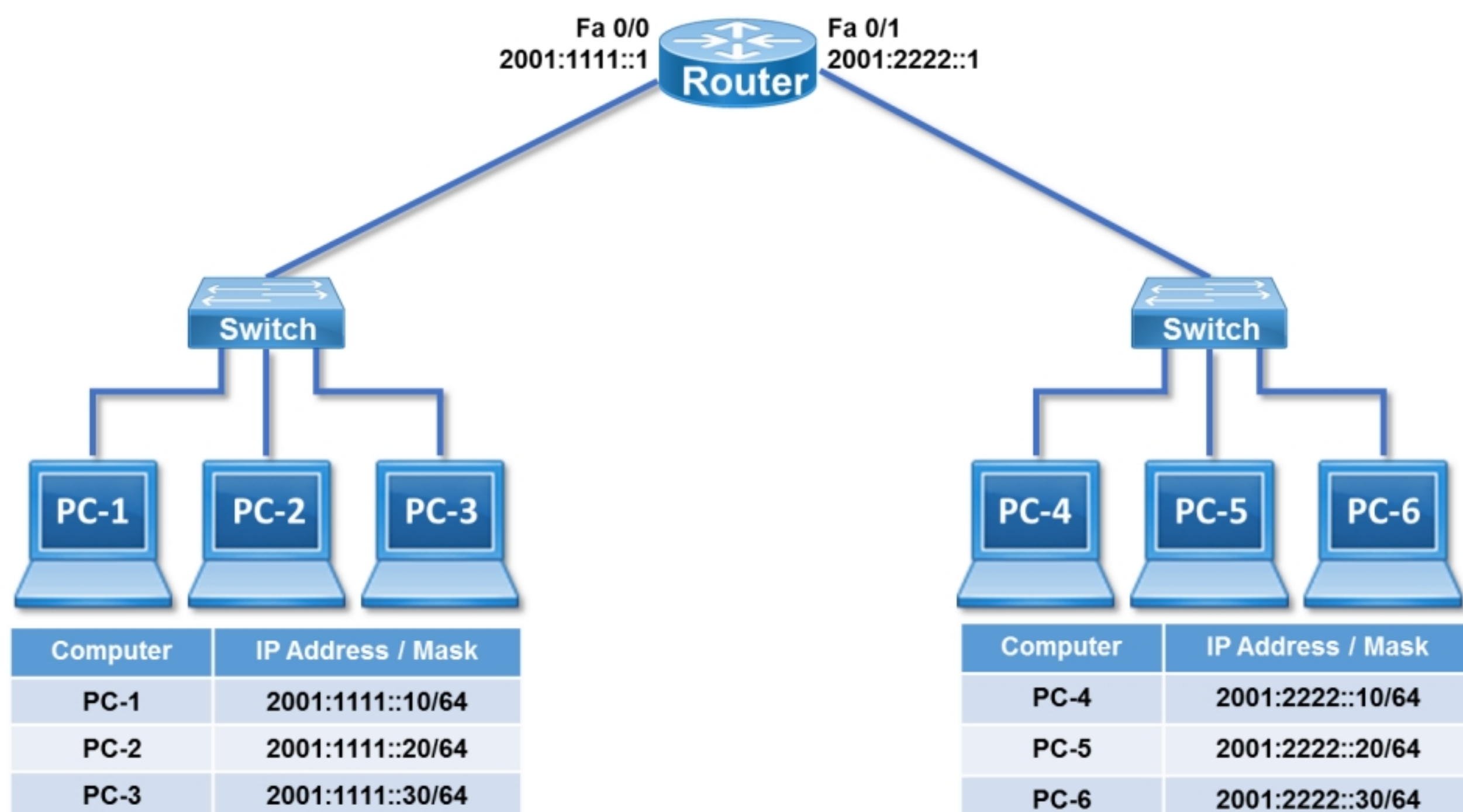
## LAB 2: UNDERSTANDING IPv6 NETWORK COMMUNICATION

### OBJECTIVE:

To verify communication between same network and different network computers after assigning IPv6 Address and Default Gateway.

### TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



### TASK:

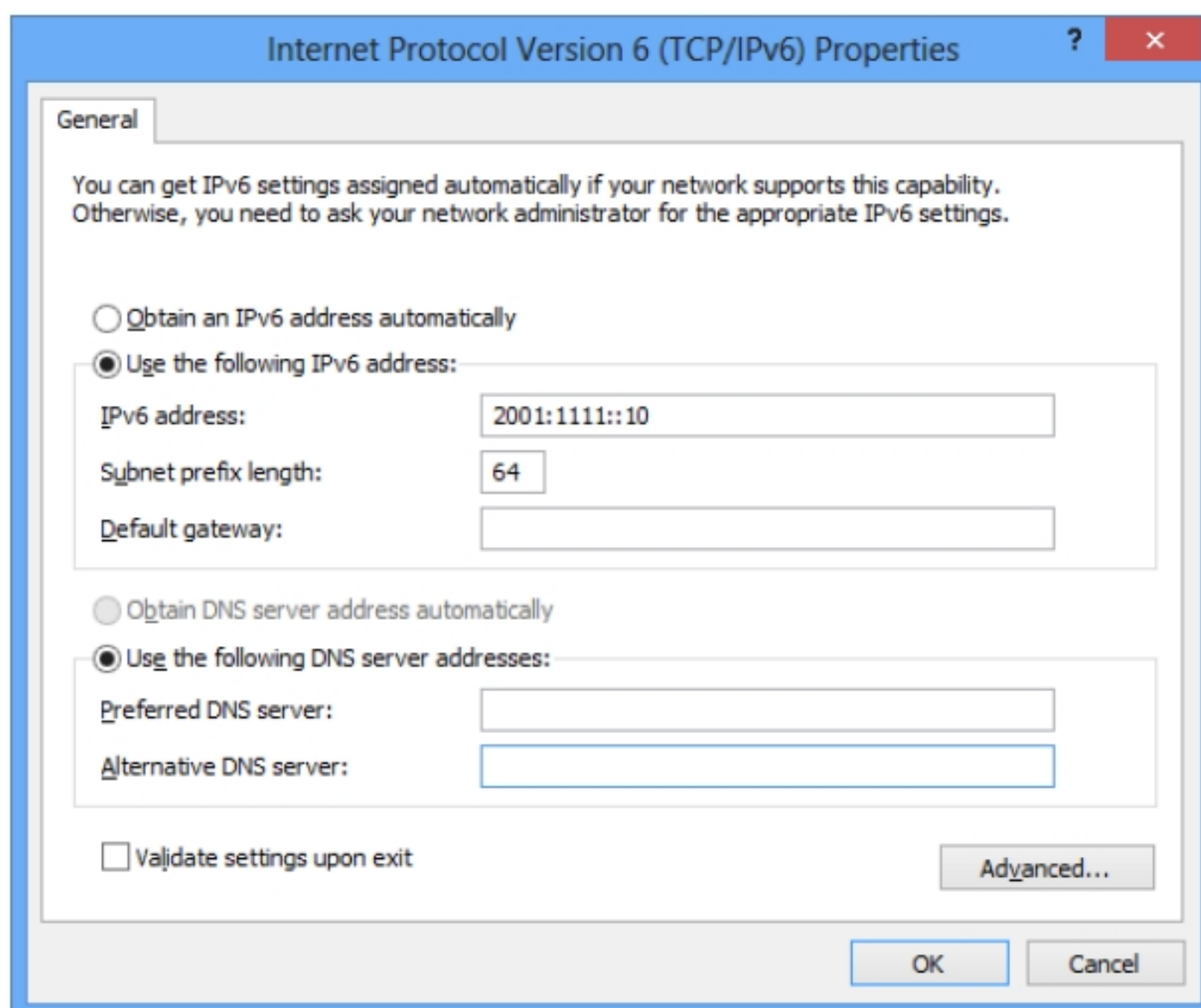
- Assigning IPv6 address to computers.
- Verify communication between the same and different network computers.
- Assigning Default Gateway address to computers.
- Verify communication between the different network computers.



## Assigning IPv6 Address to computers

### On Windows 7 or Windows 8.x or Windows 10 Computer

- Open **Network and Sharing Center**
- Click on **Change adapter settings** and Click **Open**.
- **Right-click** on your local adapter and select **Properties**.
- In the **Local Area Connection Properties** window select **Internet Protocol Version 6 (TCP/IPv6)** then click the **Properties** button.
- Now select the radio button **Use the following IPv6 address** and enter in the IP address and Subnet prefix and click **OK**.



- Verify above configured ip address by giving below command.

C:\> **ipconfig**

Windows IP Configuration

Ethernet adapter Ethernet:

Connection-specific DNS Suffix . :

IPv6 Address. . . . . : 2001:1111::10

Link-local IPv6 Address . . . . . : fe80::449d:6a9a:2c80:80dc%64

Default Gateway . . . . . :

- Repeat the above steps to configure ip address on all windows based computers.

## On Linux

- Give below command to configure ip address

```
bt ~ # ifconfig eth0 inet6 add 2001:1111::10/64
```

- To verify the configured ipv6 address by giving below command.

```
bt ~ # ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet6 2001:1111::10 prefixlen 64 scopeid 0x0<global>
    ether 44:8a:5b:d4:39:3c txqueuelen 1000 (Ethernet)
    RX packets 230 bytes 82110 (80.1 KiB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 121 bytes 19549 (19.0 KiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 0 (Local Loopback)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

- Repeat the above steps to configure ip address on all linux based computers.

## Verify communication between the same and different network computers.

### From 2001:1111::10 computer (i.e. PC1) ping other computers

#### **ping 2001:1111::20 (Windows) or ping6 2001:1111::20 (Linux)**

```
PING 2001:1111::20(2001:1111::20) 56 data bytes
64 bytes from 2001:1111::20: icmp_seq=1 ttl=64 time=0.494 ms
64 bytes from 2001:1111::20: icmp_seq=2 ttl=64 time=0.361 ms
64 bytes from 2001:1111::20: icmp_seq=3 ttl=64 time=0.335 ms
64 bytes from 2001:1111::20: icmp_seq=4 ttl=64 time=0.336 ms
```

#### **ping 2001:1111::30 (Windows) or ping6 2001:1111::30 (Linux)**

```
PING 2001:1111::30(2001:1111::30) 56 data bytes
64 bytes from 2001:1111::30: icmp_seq=1 ttl=64 time=0.494 ms
64 bytes from 2001:1111::30: icmp_seq=2 ttl=64 time=0.361 ms
64 bytes from 2001:1111::30: icmp_seq=3 ttl=64 time=0.335 ms
64 bytes from 2001:1111::30: icmp_seq=4 ttl=64 time=0.336 ms
```

#### **ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)**

```
connect: Network is unreachable
```



**From 2001:2222::10 computer (i.e. PC4) ping other computers****ping 2001:2222::20 (Windows) or ping6 2001:2222::20 (Linux)**

```
PING 2001:2222::20(2001:2222::20) 56 data bytes
64 bytes from 2001:2222::20: icmp_seq=1 ttl=64 time=0.494 ms
64 bytes from 2001:2222::20: icmp_seq=2 ttl=64 time=0.361 ms
64 bytes from 2001:2222::20: icmp_seq=3 ttl=64 time=0.335 ms
64 bytes from 2001:2222::20: icmp_seq=4 ttl=64 time=0.336 ms
```

**ping 2001:2222::30 (Windows) or ping6 2001:2222::30 (Linux)**

```
PING 2001:2222::30(2001:2222::30) 56 data bytes
64 bytes from 2001:2222::30: icmp_seq=1 ttl=64 time=0.494 ms
64 bytes from 2001:2222::30: icmp_seq=2 ttl=64 time=0.361 ms
64 bytes from 2001:2222::30: icmp_seq=3 ttl=64 time=0.335 ms
64 bytes from 2001:2222::30: icmp_seq=4 ttl=64 time=0.336 ms
```

**ping 2001:1111::10 (Windows) or ping6 2001:1111::10 (Linux)**

connect: Network is unreachable

**From 2001:1111::10 computer (i.e. PC1) trace network communication path to other computers****tracert 2001:1111::20 (Windows) or traceroute6 2001:1111::20 (Linux)**

```
traceroute to 2001:1111::20 (2001:1111::20) from 2001:1111::10, 30 hops max, 16 byte
 1  2001:1111::20 (2001:1111::20)  3005.56 ms !H  3006.88 ms !H  3005.99
```

**tracert 2001:1111::30 (Windows) or traceroute6 2001:1111::30 (Linux)**

```
traceroute to 2001:1111::30 (2001:1111::30) from 2001:1111::10, 30 hops max, 16 byte
 1  2001:1111::30 (2001:1111::20)  3005.56 ms !H  3006.88 ms !H  3005.99
```

**From 2001:2222::10 computer (i.e. PC4) trace network communication path to other computers****tracert 2001:2222::20 (Windows) or traceroute6 2001:2222::20 (Linux)**

```
traceroute to 2001:2222::20 (2001:2222::20) from 2001:2222::10, 30 hops max, 16 byte
 1  2001:2222::20 (2001:2222::20)  3005.56 ms !H  3006.88 ms !H  3005.99
```

**tracert 2001:2222::30 (Windows) or traceroute6 2001:2222::30 (Linux)**

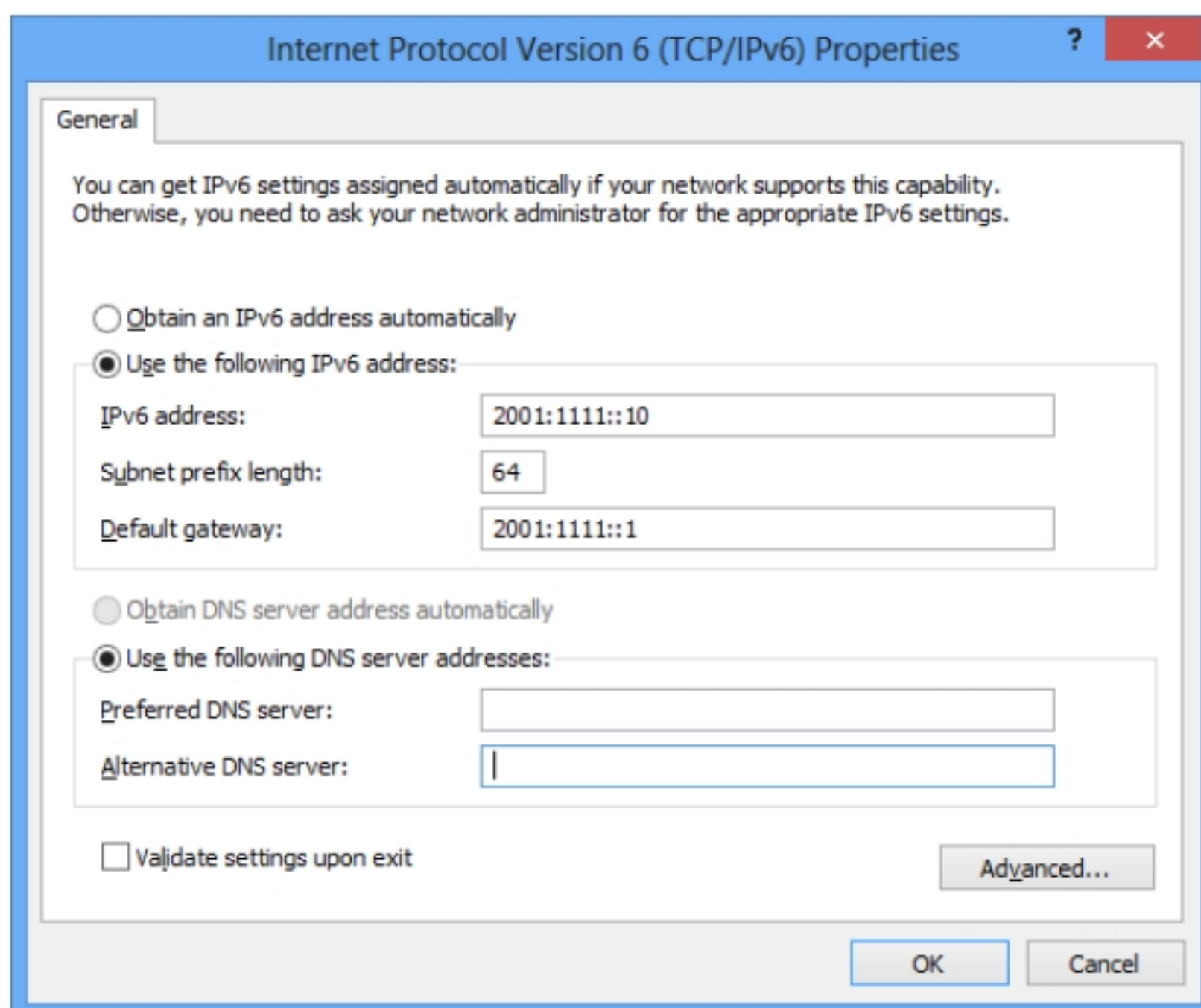
```
traceroute to 2001:2222::30 (2001:2222::30) from 2001:2222::10, 30 hops max, 16 byte
 1  2001:2222::30 (2001:2222::20)  3005.56 ms !H  3006.88 ms !H  3005.99
```



## Assigning Default Gateway address to computers

### On Windows 7 or Windows 8.x or Windows 10 Computer

- Open **Network and Sharing Center**
- Click on **Change adapter settings** and Click **Open**.
- **Right-click** on your local adapter and select **Properties**.
- In the **Local Area Connection Properties** window select **Internet Protocol Version 6 (TCP/IPv6)** then click the **Properties** button.
- Now select the radio button **Use the following IPv6 address** and enter **Default Gateway** and click **OK**.



- Verify above configured default gateway by giving below command.

C:\> **ipconfig**

Windows IP Configuration

Ethernet adapter Ethernet:

Connection-specific DNS Suffix . :

IPv6 Address. . . . . : 2001:1111::10

Link-local IPv6 Address . . . . . : fe80::449d:6a9a:2c80:80dc%64

Default Gateway . . . . . : 2001:1111::1

- Repeat the above steps to configure default gateway on all windows based computers.

## On Linux

- Give below command to configure default gateway

```
bt ~ # route -6 add default gw 2001:1111::1
```

- To verify the configure default gateway by giving below command.

```
bt ~ # route -6
Kernel IPv6 routing table
```

| Destination                   | Next Hop     | Flag | Met | Ref | Use | If   |
|-------------------------------|--------------|------|-----|-----|-----|------|
| ::1/128                       | ::           | Un   | 0   | 1   | 0   | lo   |
| 2001:1111::/64                | ::           | U    | 256 | 0   | 2   | eth0 |
| fe80::468a:5bff:fed4:3899/128 | ::           | Un   | 0   | 1   | 0   | lo   |
| fe80::/64                     | ::           | U    | 256 | 0   | 0   | eth0 |
| ff00::/8                      | ::           | U    | 256 | 0   | 0   | eth0 |
| ::/0                          | 2001:1111::1 | UG   | 1   | 0   | 0   | eth0 |

```
bt ~ #
```

- Repeat the above steps to configure default gateway on all linux based computers.

## Verify communication between the different network computers.

### From 2001:1111::10 computer (i.e. PC1) ping other computers

**ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)**

```
PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=63 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=63 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=63 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=63 time=0.336 ms
```

**ping 2001:2222::20 (Windows) or ping6 2001:2222::20 (Linux)**

```
PING 2001:2222::20(2001:2222::20) 56 data bytes
64 bytes from 2001:2222::20: icmp_seq=1 ttl=63 time=0.494 ms
64 bytes from 2001:2222::20: icmp_seq=2 ttl=63 time=0.361 ms
64 bytes from 2001:2222::20: icmp_seq=3 ttl=63 time=0.335 ms
64 bytes from 2001:2222::20: icmp_seq=4 ttl=63 time=0.336 ms
```

**ping 2001:2222::30 (Windows) or ping6 2001:2222::30 (Linux)**

```
PING 2001:2222::30(2001:2222::30) 56 data bytes
64 bytes from 2001:2222::30: icmp_seq=1 ttl=63 time=0.494 ms
64 bytes from 2001:2222::30: icmp_seq=2 ttl=63 time=0.361 ms
64 bytes from 2001:2222::30: icmp_seq=3 ttl=63 time=0.335 ms
64 bytes from 2001:2222::30: icmp_seq=4 ttl=63 time=0.336 ms
```



**From 2001:2222::10 computer (i.e. PC4) ping other computers****ping 2001:1111::10 (Windows) or ping6 2001:1111::10 (Linux)**

```
PING 2001:1111::10(2001:1111::10) 56 data bytes
64 bytes from 2001:1111::10: icmp_seq=1 ttl=63 time=0.494 ms
64 bytes from 2001:1111::10: icmp_seq=2 ttl=63 time=0.361 ms
64 bytes from 2001:1111::10: icmp_seq=3 ttl=63 time=0.335 ms
64 bytes from 2001:1111::10: icmp_seq=4 ttl=63 time=0.336 ms
```

**ping 2001:1111::20 (Windows) or ping6 2001:1111::20 (Linux)**

```
PING 2001:1111::20(2001:1111::20) 56 data bytes
64 bytes from 2001:1111::20: icmp_seq=1 ttl=63 time=0.494 ms
64 bytes from 2001:1111::20: icmp_seq=2 ttl=63 time=0.361 ms
64 bytes from 2001:1111::20: icmp_seq=3 ttl=63 time=0.335 ms
64 bytes from 2001:1111::20: icmp_seq=4 ttl=63 time=0.336 ms
```

**ping 2001:1111::30 (Windows) or ping6 2001:1111::30 (Linux)**

```
PING 2001:1111::30(2001:1111::30) 56 data bytes
64 bytes from 2001:1111::30: icmp_seq=1 ttl=63 time=0.494 ms
64 bytes from 2001:1111::30: icmp_seq=2 ttl=63 time=0.361 ms
64 bytes from 2001:1111::30: icmp_seq=3 ttl=63 time=0.335 ms
64 bytes from 2001:1111::30: icmp_seq=4 ttl=63 time=0.336 ms
```

**From 2001:1111::10 computer (i.e. PC1) trace network communication path to other computers****tracert 2001:2222::10 (Windows) or traceroute6 2001:2222::10 (Linux)**

```
traceroute to 2001:2222::10 (2001:2222::10) from 2001:1111::10, 30 hops max, 16 byte
 1  2001:1111::1 (2001:1111::1)  1.12 ms  1.012 ms  1.039 ms
 2  2001:2222::10 (2001:2222::10)  1.111 ms  0.884 ms  0.861 ms
```

**tracert 2001:2222::20 (Windows) or traceroute6 2001:2222::20 (Linux)**

```
traceroute to 2001:2222::20 (2001:2222::20) from 2001:1111::10, 30 hops max, 16 byte
 1  2001:1111::1 (2001:1111::1)  1.12 ms  1.012 ms  1.039 ms
 2  2001:2222::20 (2001:2222::20)  1.111 ms  0.884 ms  0.861 ms
```

**From 2001:2222::10 computer (i.e. PC4) trace network communication path to other computers****tracert 2001:1111::10 (Windows) or traceroute6 2001:1111::10 (Linux)**

```
traceroute to 2001:1111::10 (2001:1111::10) from 2001:2222::10, 30 hops max, 16 byte
 1  2001:2222::1 (2001:2222::1)  1.12 ms  1.012 ms  1.039 ms
 2  2001:1111::10 (2001:1111::10)  1.111 ms  0.884 ms  0.861 ms
```

**tracert 2001:1111::20 (Windows) or traceroute6 2001:1111::20 (Linux)**

```
traceroute to 2001:1111::20 (2001:1111::20) from 2001:2222::10, 30 hops max, 16 byte
 1  2001:2222::1 (2001:2222::1)  1.12 ms  1.012 ms  1.039 ms
 2  2001:1111::20 (2001:1111::20)  1.111 ms  0.884 ms  0.861 ms
```



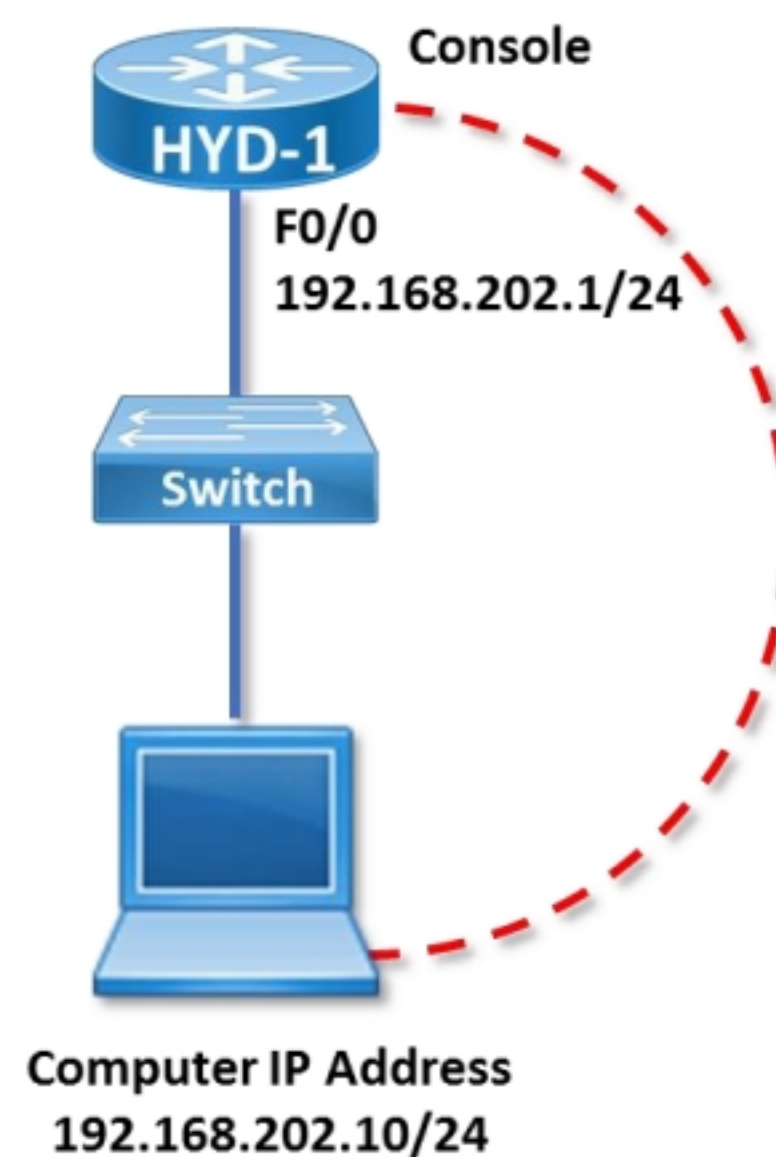
## LAB 3: INITIAL CONFIGURATION OF ROUTER - IPv4 NETWORK

### OBJECTIVE:

To get familiarized with Cisco IOS modes and configure a new Router with basic configuration i.e. assign IPv4 address on the interfaces and configure passwords etc.

### TOPOLOGY:

Setup Console and Ethernet connectivity for the lab as below :

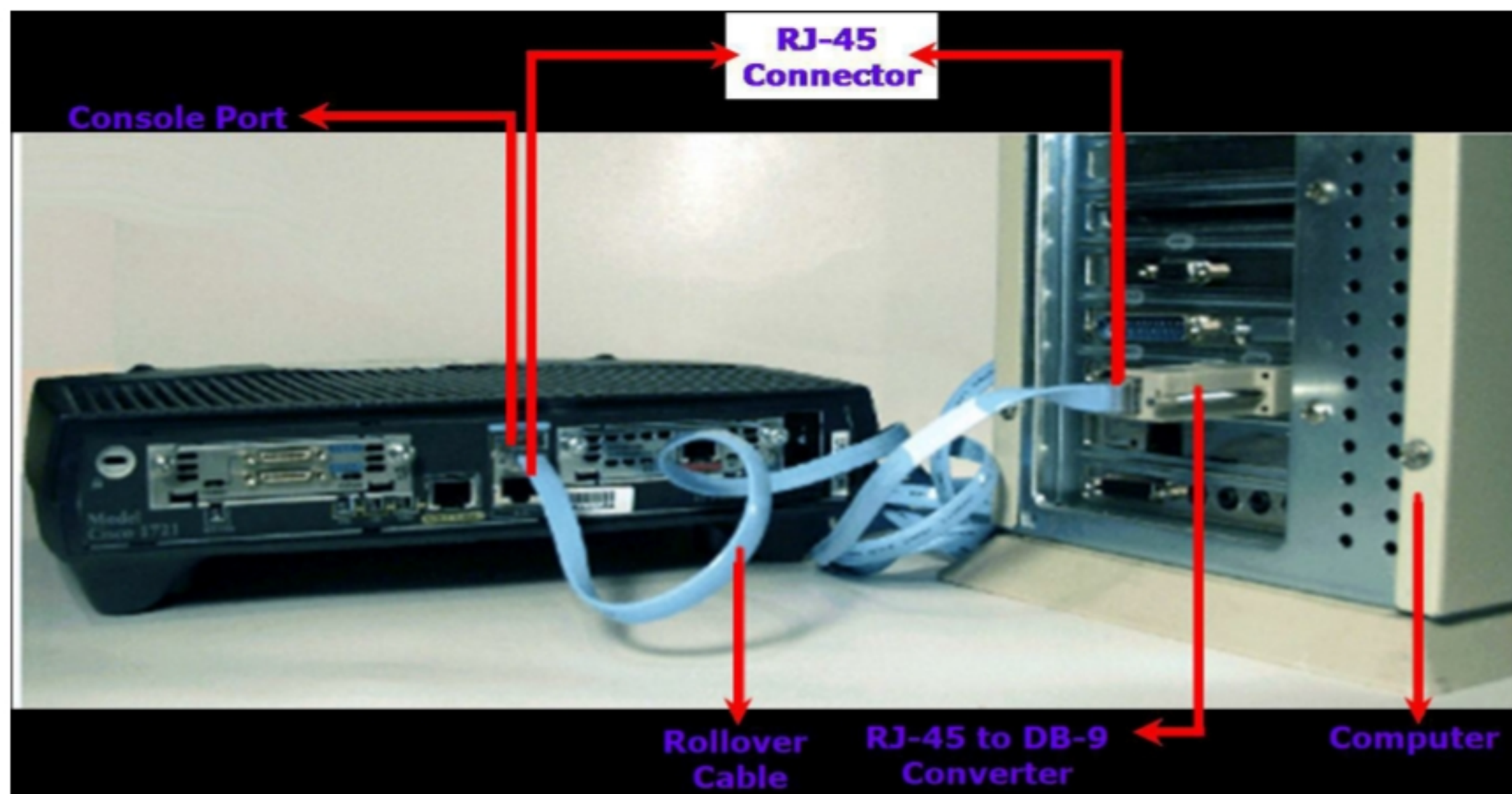


### TASK:

- Establish console connectivity
- Access router via console with an emulation software
- Get to know Cisco IOS Modes and Show commands
- Configure Hostname and Interface IP address
- Configure Connectivity Passwords
- Configure Privilege Mode / Enable Password
- Verify configuration in RAM and NVRAM
- Saving configuration to the router
- Access the router via Telnet

### Establish console connectivity

Establish console connectivity by connecting Router console port to PC Com Port with console cable as shown in the picture below:



### Access router via console with an emulation software

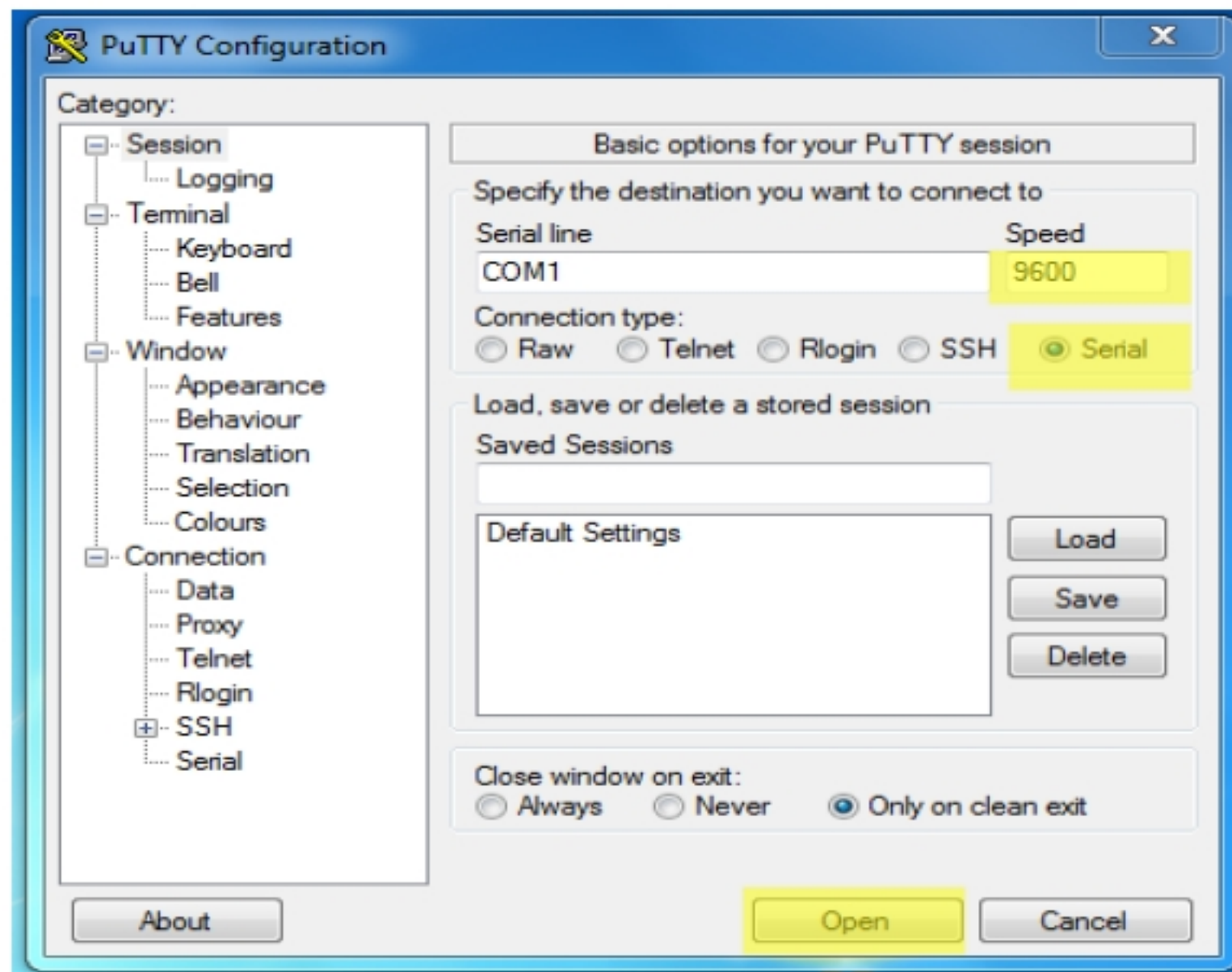
Configure the following parameters in emulation software for accessing router via console port.

| Parameters | Console Port Settings |
|------------|-----------------------|
| Baud       | 9600                  |
| Data bits  | 8                     |
| Parity     | None                  |
| Stop bits  | 1                     |



### Accessing router via console from Microsoft Windows Computer

- Start a terminal emulator application, such as **PUTTY.exe**
- Select **Serial** option and set speed to **9600**.
- Click **Open**

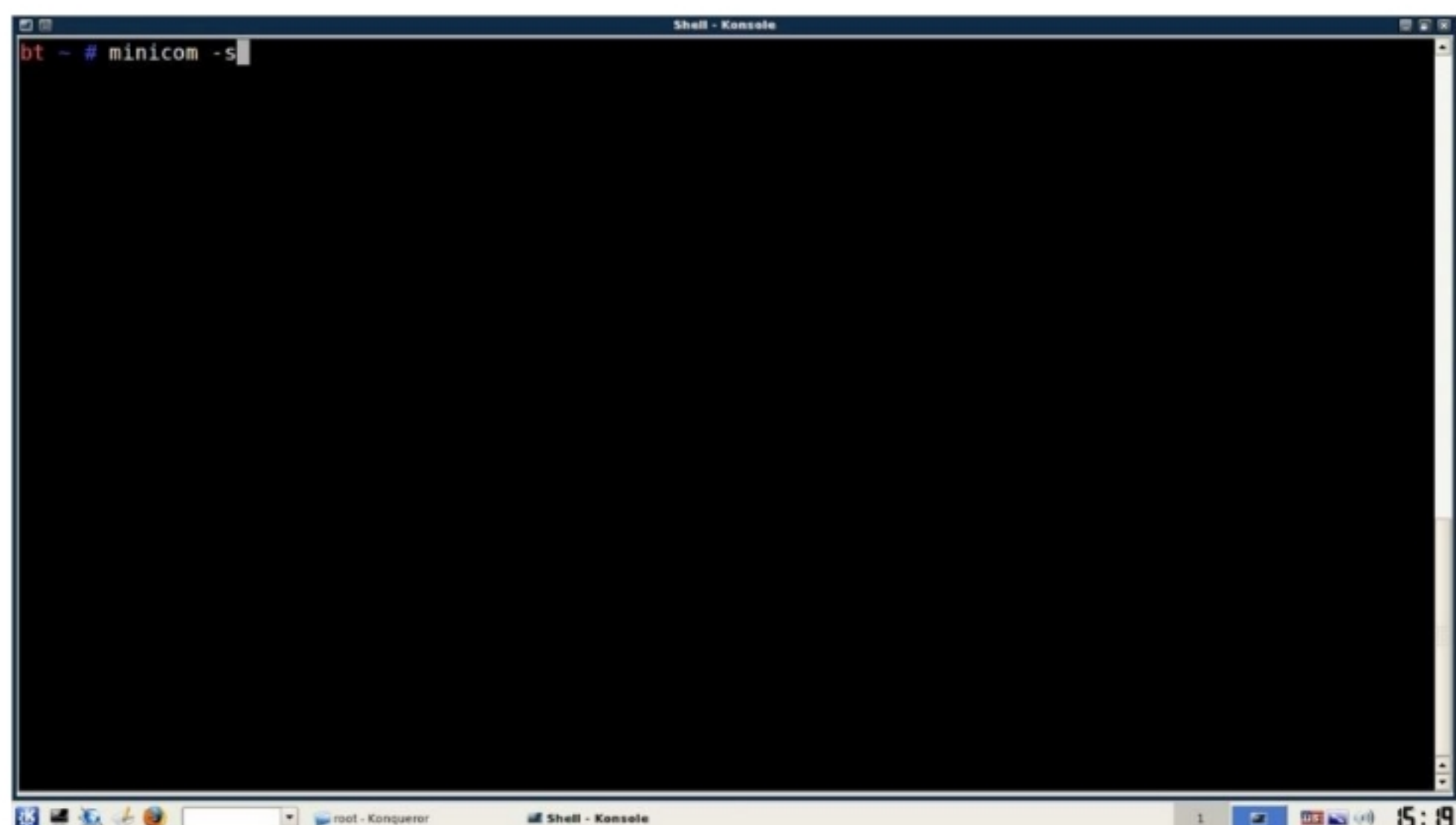


- Once emulation software is ready, **Power-ON** the Router.

### Accessing router via console from Linux Computer

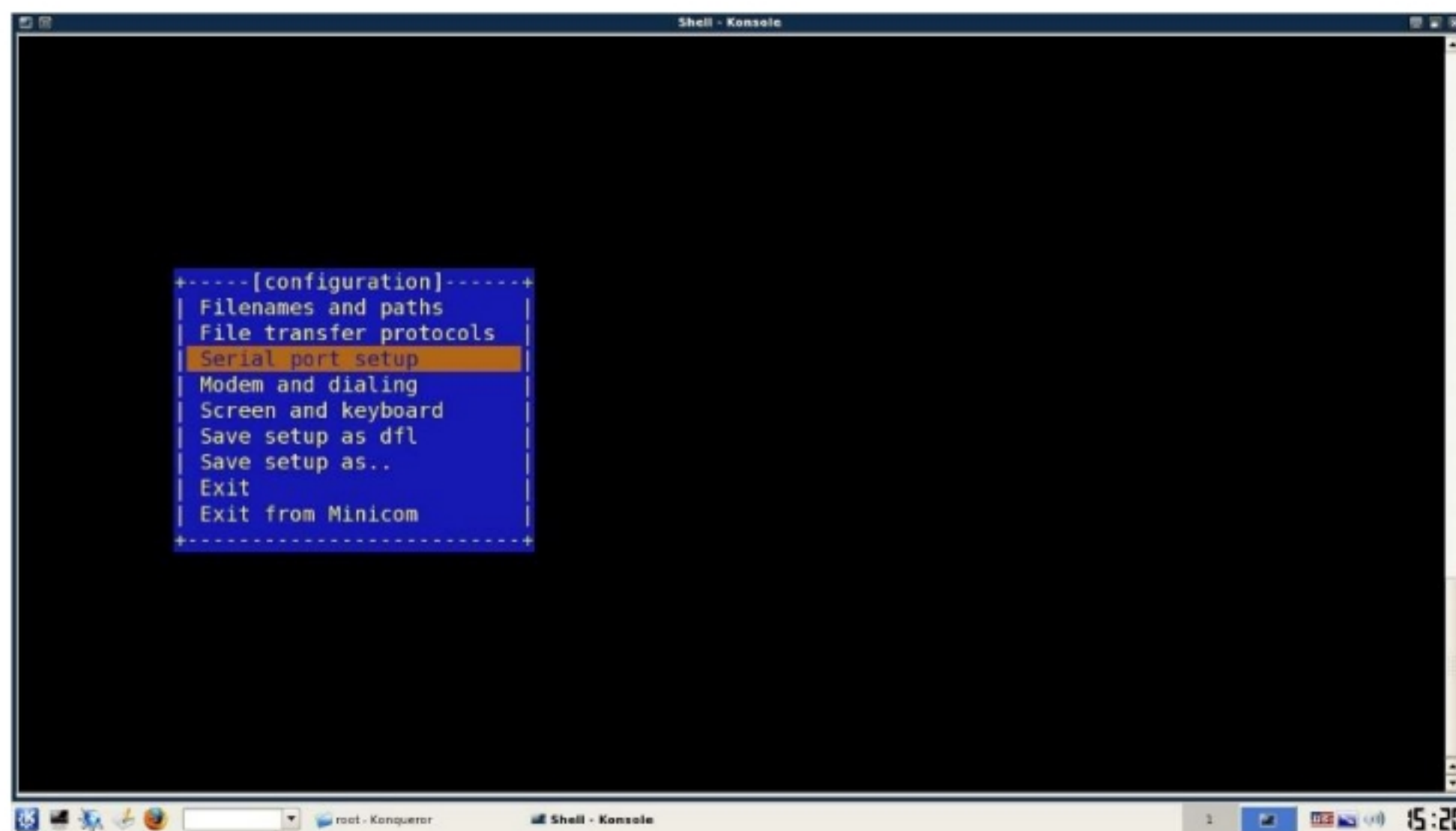
- From the terminal enter the below command

**# minicom -s**

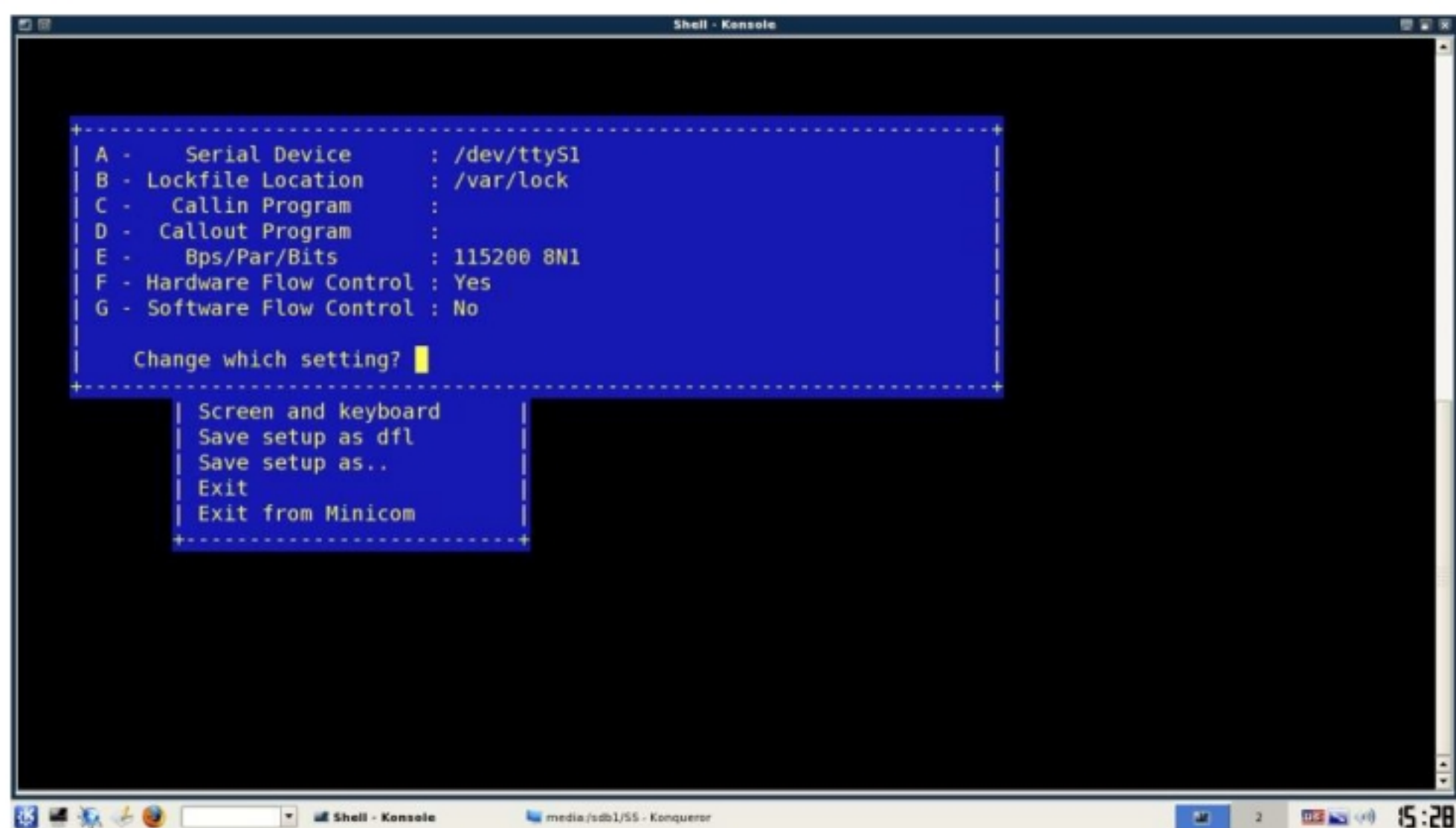




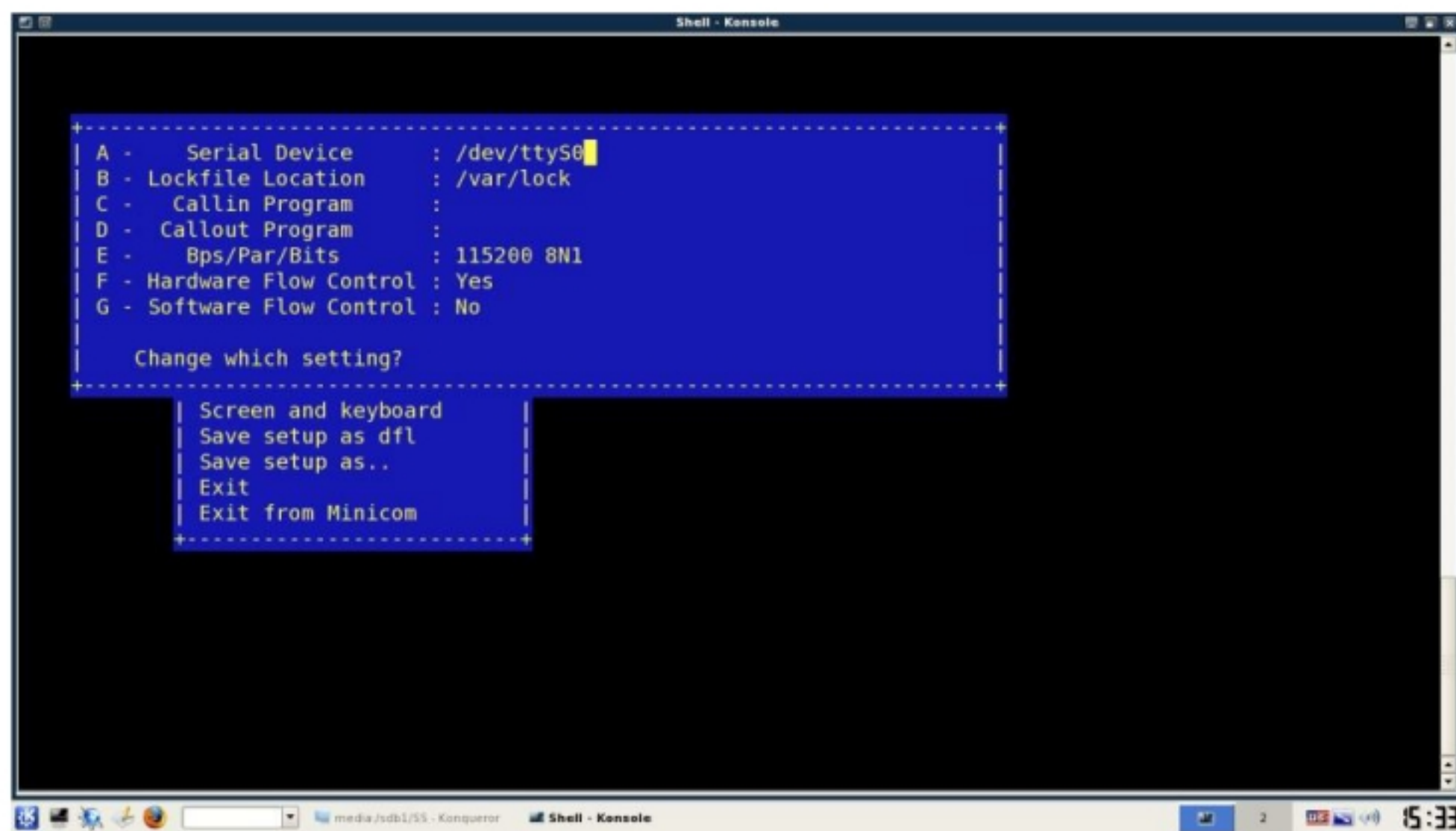
- Select Serial port Setup and press enter



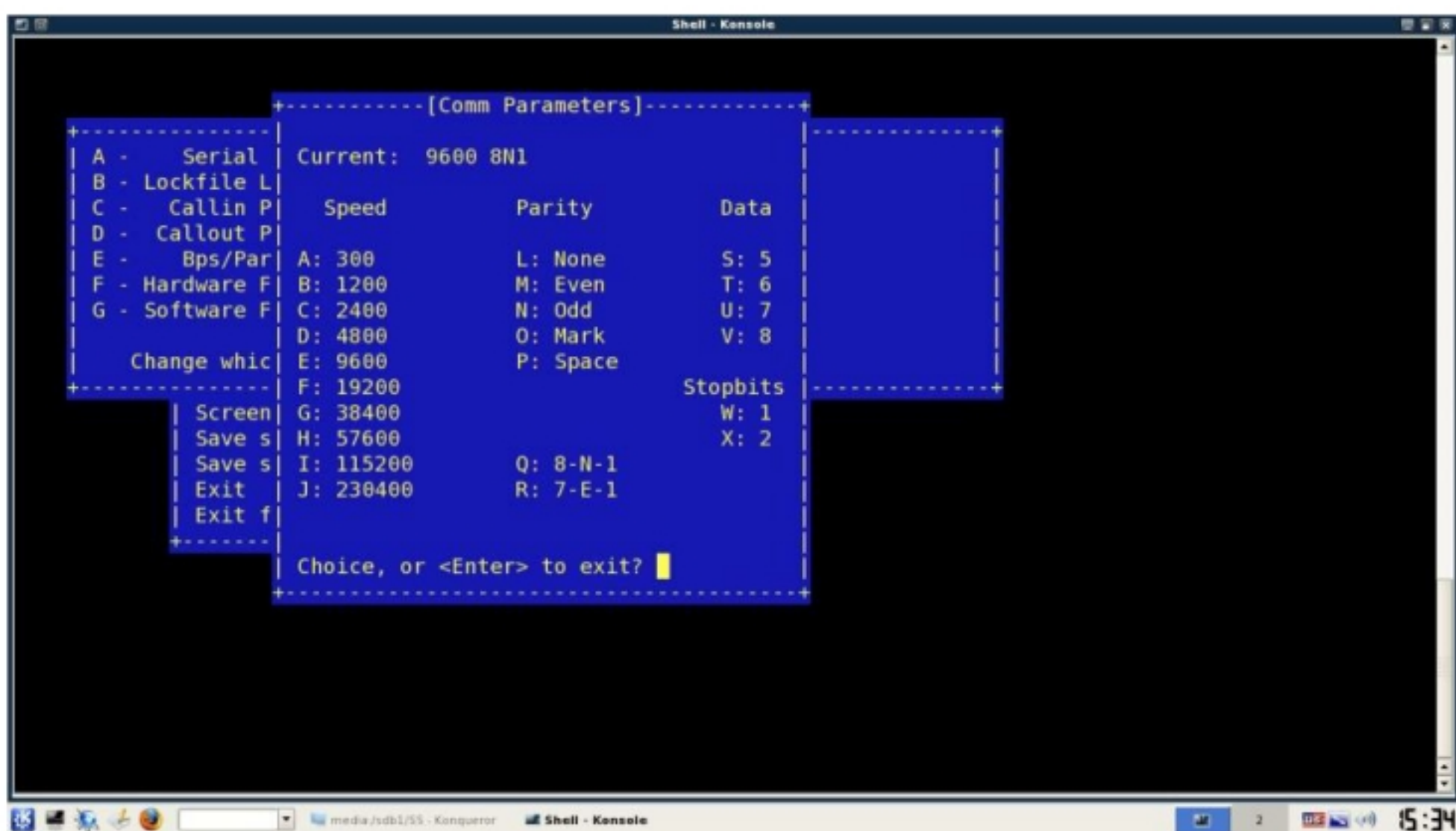
- It will display default **COM Port Settings**.



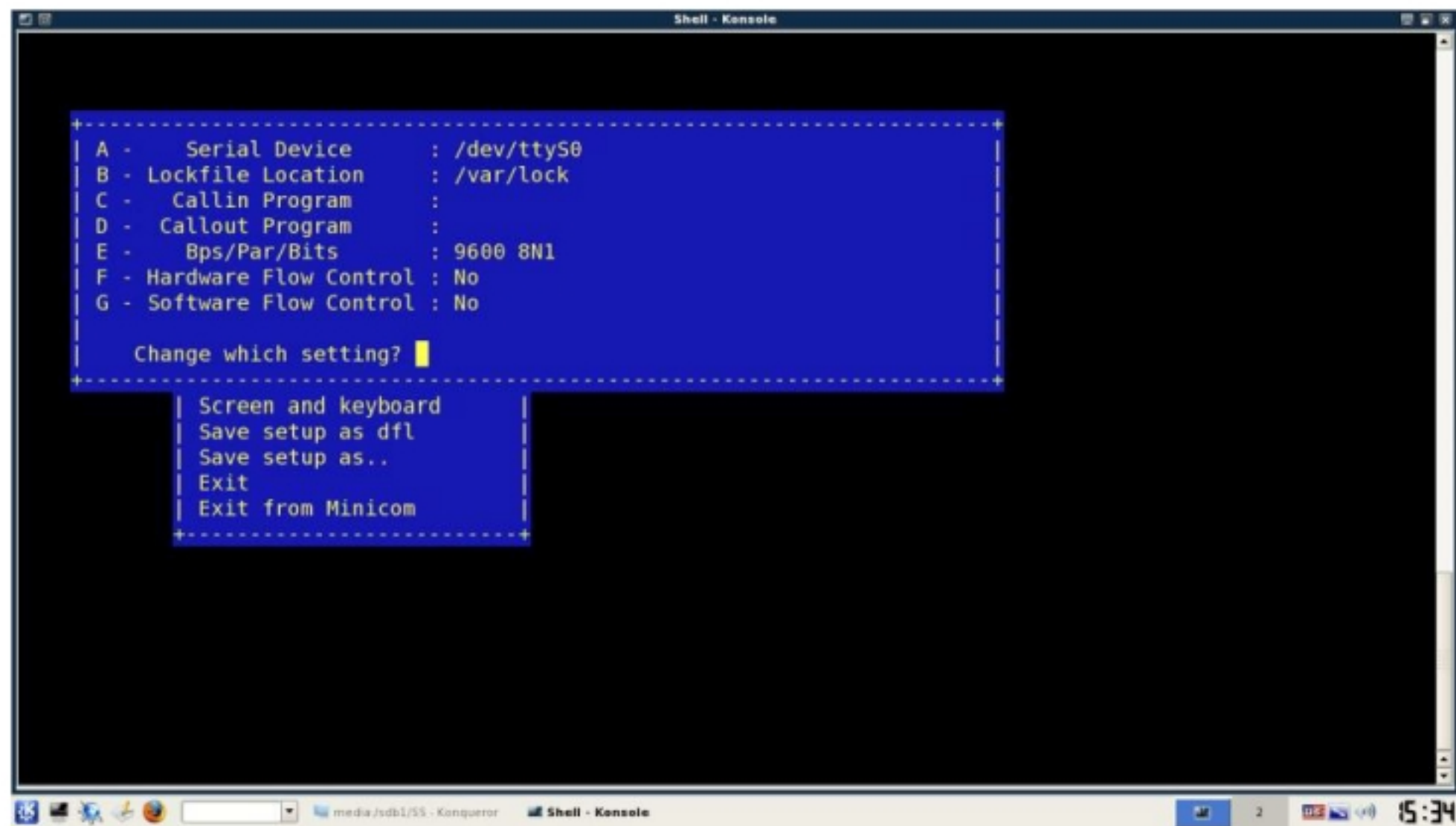
- Specify **COM Port** where console cable is connected by pressing "**a**" and use backspace to delete "**1**" and add "**0**".



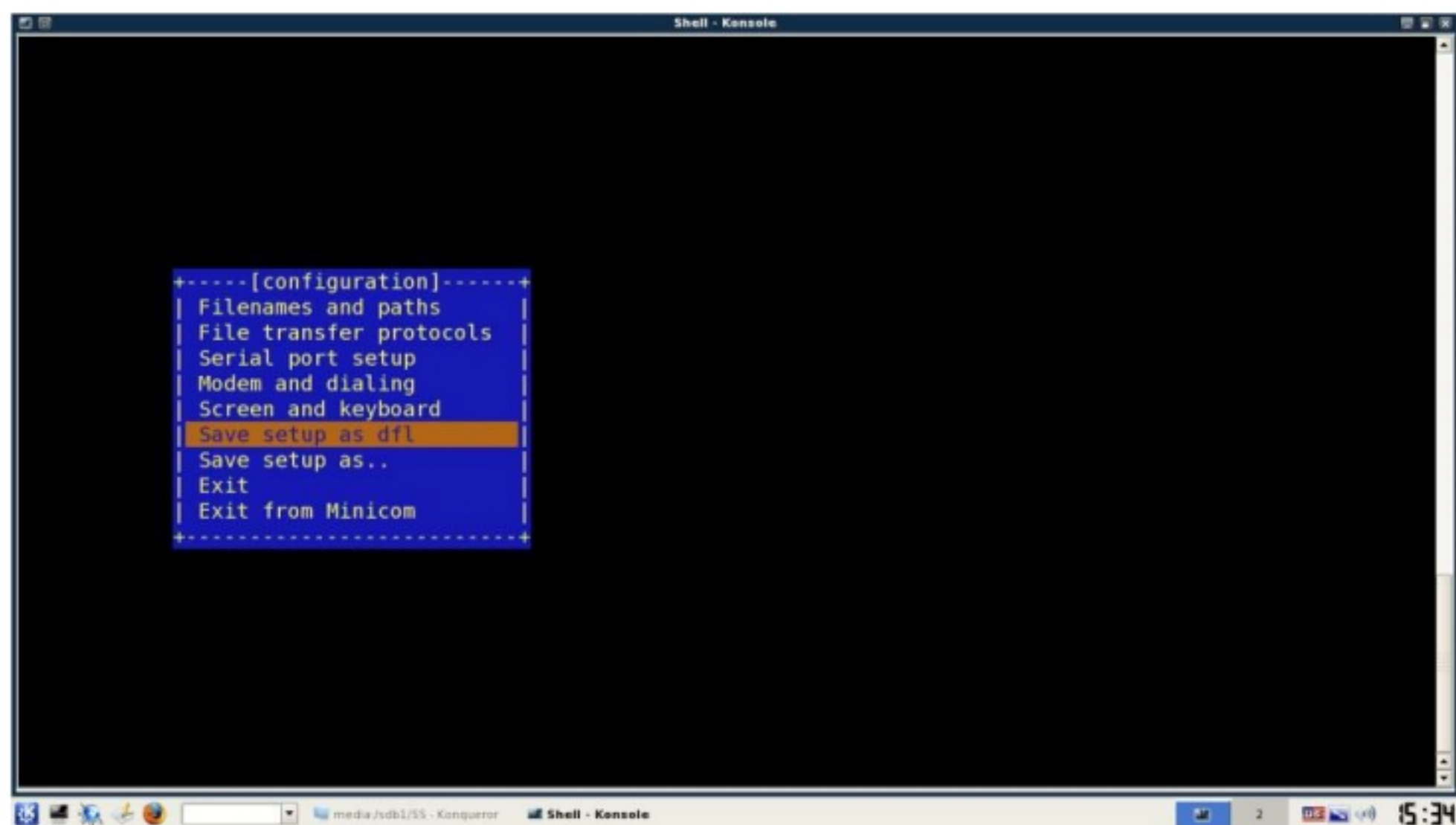
- Change the **Bps Setting** to **9600** by pressing "**e**" and select the alphabet matching to speed "**9600**".



- Change the **Hardware Flow Control** option to **No** by pressing "F".

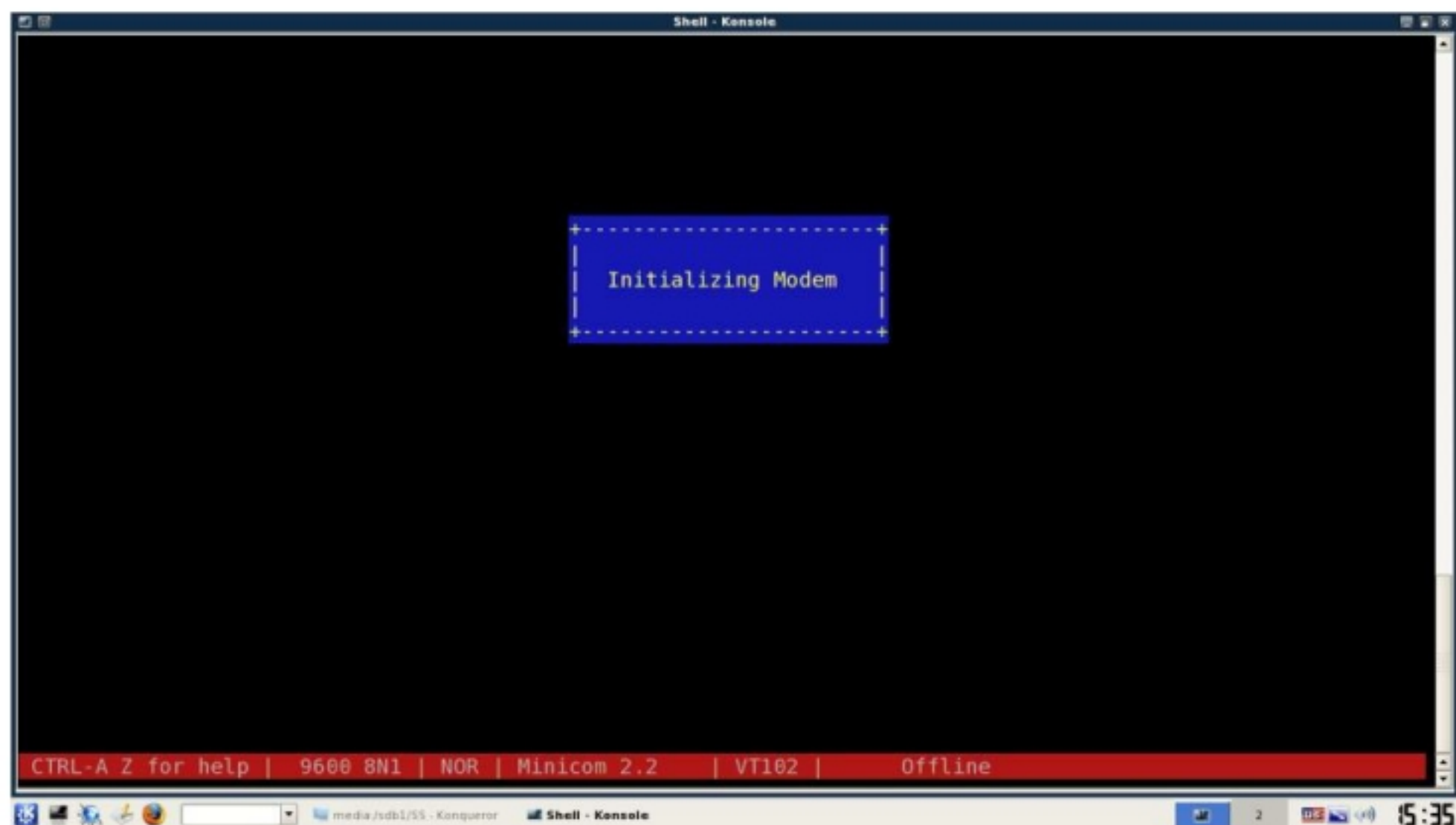


- Select **Save Setup as dfl** option.





- Select "**Exit**" option.



- Once emulation software is ready, **Power-ON** the Router.

### Get to know Cisco IOS Modes and Show commands

After the Router boots-up completely, (on a new Cisco Router) it enters setup mode as below:

```
--- System Configuration Dialog ---
Would you like to enter the initial configuration dialog? [yes/no]: no
Would you like to terminate autoinstall? [yes]: yes
```

If you choose “Yes”, IOS will prompt questions to gather the information to configure the Router, it is recommended to choose “no”, since we can configure the Router using IOS commands

```
Router >
```

**To navigate into Privilege mode/Executive Mode from User Mode and Vice-Versa**

```
Router>enable
```

```
Router #
```

```
Router# disable
```

```
Router >
```

**To view router IOS and hardware information**

Router # **show version**

Cisco IOS Software, 2800 Software (C2800NM-ADVENTERPRISEK9-M), Version 15.1)

Technical Support: <http://www.cisco.com/techsupport>

Copyright (c) 1986-2015 by Cisco Systems, Inc.

Compiled Tue 24-Mar-15 09:00 by prod\_rel\_team

ROM: System Bootstrap, Version 12.4(13r)T, RELEASE SOFTWARE (fc1)

Router uptime is 56 minutes

System returned to ROM by reload at 08:19:55 UTC Sat Jul 9 2016

System image file is "flash:c2800nm-adventerprisek9-mz.151-4.M10.bin"

Last reload type: Normal Reload

This product contains cryptographic features and is subject to United States and local country laws governing import, export, transfer and use. Delivery of Cisco cryptographic products does not imply third-party authority to import, export, distribute or use encryption. Importers, exporters, distributors and users are responsible for compliance with U.S. and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:

<http://www.cisco.com/wwl/export/crypto/tool/stqrg.html>

If you require further assistance please contact us by sending email to [export@cisco.com](mailto:export@cisco.com).

Cisco 2811 (revision 1.0) with 249856K/12288K bytes of memory.

Processor board ID FHK1109F34X

2 FastEthernet interfaces

2 Serial(sync/async) interfaces

1 Virtual Private Network (VPN) Module

DRAM configuration is 64 bits wide with parity enabled.

239K bytes of non-volatile configuration memory.

125440K bytes of ATA CompactFlash (Read/Write)

License Info:

License UDI:

```
-----  
Device#  PID          SN  
-----  
*0      CISCO2811      FHK1109F34X
```

Configuration register is 0x2102

Router#



**To view router flash Information**

Router # **show flash**

-#- ---length--- -----date/time----- path

1 1 Jan 1 2016 13:54:52 +00:00 redirect.out

2 67926080 Sep 5 2015 14:59:38 +00:00 c2800nm-adventerprisek9-mz.151n

60235776 bytes available (67932160 bytes used)

**To view router current configuration (RAM)**

Router # **show running-config**

Current configuration : 1010 bytes

!

version 15.1

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

!

hostname Router

!

boot-start-marker

boot-end-marker

!

no aaa new-model!

dot11 syslog

ip source-route!

ip cef

!

no ipv6 cef

!

multilink bundle-name authenticated!

!

crypto pki token default removal timeout 0

!

license udi pid CISCO2811 sn FHK1109F34X

!

redundancy

!

interface FastEthernet0/0

no ip address

shutdown

duplex auto

speed auto

!

interface FastEthernet0/1

no ip address

shutdown

duplex auto

speed auto

!



```
interface Serial0/0/0
no ip address
shutdown
no fair-queue
!
interface Serial0/0/1
no ip address
shutdown
!
ip forward-protocol nd
no ip http server
no ip http secure-server
!
control-plane
!
mgcp profile default
line con 0
line aux 0
line vty 0 4
login
transport input all
!
scheduler allocate 20000 1000
end
```

Router#

#### **To view router startup configuration (NVRAM)**

```
Router# show startup-config
startup-config is not present
```

#### **To navigate into Global Configuration Mode**

```
Router # configure terminal
Router (config) #
```

#### **Configure Hostname and Interface IP address**

##### **To change the Host Name of Router**

```
Router (config) # hostname HYD-1
HYD-1 (config) #
```

##### **To configure IP address on Ethernet Interface (LAN interface)**

```
HYD-1 (config) # interface FastEthernet 0/0
HYD-1 (config-if) # ip address 192.168.202.1 255.255.255.0
HYD-1 (config-if) # no shutdown
HYD-1 (config-if) # exit
```

## Configure Connectivity Passwords

### To configure telnet password

```
HYD-1 (config) # line vty 0 4
HYD-1 (config-line) # password zoom
HYD-1 (config-line) # login
HYD-1 (config-line) # exit
```

### To configure console password

```
HYD-1 (config) # line console 0
HYD-1 (config-line) # password ccna
HYD-1 (config-line) # login
HYD-1 (config-line) # exit
```

### To configure auxiliary password

```
HYD-1 (config) # line aux 0
HYD-1 (config-line) # password cisco
HYD-1 (config-line) # login
HYD-1 (config-line) # exit
```

## Configure Privilege Mode / Enable Password

### Configure privilege password

```
HYD-1 (config) # enable password ccna
HYD-1 (config) # enable secret zoom
```

## Verify configuration in RAM and NVRAM

### To View Router Current Configuration (RAM)

```
HYD-1 # show running-config
```

```
Current configuration : 1241 bytes
!
Last configuration change at 08:37:39 UTC Sat Jul 9 2016
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname HYD-1
!
boot-start-marker
boot-end-marker
!
```

```
!  
enable secret 5 $1$DMgk$ITC7TUZVwFn5969wEB2mw.  
enable password ccna  
!  
no aaa new-model  
!  
dot11 syslog  
ip source-route  
!  
ip cef  
!  
no ipv6 cef  
!  
multilink bundle-name authenticated  
crypto pki token default removal timeout 0  
!  
license udi pid CISCO2811 sn FHK1109F34X  
!  
redundancy  
!  
interface FastEthernet0/0  
ip address 192.168.202.1 255.255.255.0  
duplex auto  
speed auto  
!  
interface FastEthernet0/1  
no ip address  
shutdown  
duplex auto  
speed auto  
!  
interface Serial0/0/0  
no ip address  
shutdown  
no fair-queue  
!  
interface Serial0/0/1  
no ip address  
shutdown  
!  
ip forward-protocol nd  
no ip http server  
no ip http secure-server!  
control-plane  
!  
mgcp profile default  
!  
!  
!  
!  
!
```



```
!  
line con 0  
password ccna  
login  
line aux 0  
password cisco  
login  
line vty 0 4  
password zoom  
login  
transport input all  
!  
scheduler allocate 20000 1000  
end
```

### To View Router Startup Configuration (NVRAM)

```
HYD-1 # show startup-config  
startup-config is not present
```

### Saving configuration to the router

#### To save configuration on router

```
HYD-1 # write memory  
Destination filename [startup-config]?  
Building configuration...
```

```
[OK]  
HYD-1 #
```

#### To view router startup configuration (NVRAM)

```
HYD-1 # show startup-config  
Current configuration : 1241 bytes  
!  
Last configuration change at 08:40:39 UTC Sat Jul 9 2016  
version 15.1  
service timestamps debug datetime msec  
service timestamps log datetime msec  
no service password-encryption  
!  
hostname HYD-1  
!  
boot-start-marker  
boot-end-marker  
!  
!
```

```
enable secret 5 $1$DMgk$ITC7TUZVwFn5969wEB2mw.
enable password ccna
!
no aaa new-model
!
dot11 syslog
ip source-route
!
ip cef
!
no ipv6 cef
!
multilink bundle-name authenticated
crypto pki token default removal timeout 0
!
license udi pid CISCO2811 sn FHK1109F34X
!
redundancy
!
interface FastEthernet0/0
ip address 192.168.202.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet0/1
no ip address
shutdown
duplex auto
speed auto
!
interface Serial0/0/0
no ip address
shutdown
no fair-queue
!
interface Serial0/0/1
no ip address
shutdown
!
!
ip forward-protocol nd
no ip http server
no ip http secure-server!
control-plane
!
!
mgcp profile default!
!
line con 0
password ccna
login
```

```
line aux 0
password cisco
login
line vty 0 4
password zoom
login
transport input all
!
scheduler allocate 20000 1000
end
```

### Access the router via Telnet

- Accessing router via telnet by giving below command on a Windows or Linux computer.

**telnet 192.168.202.1**





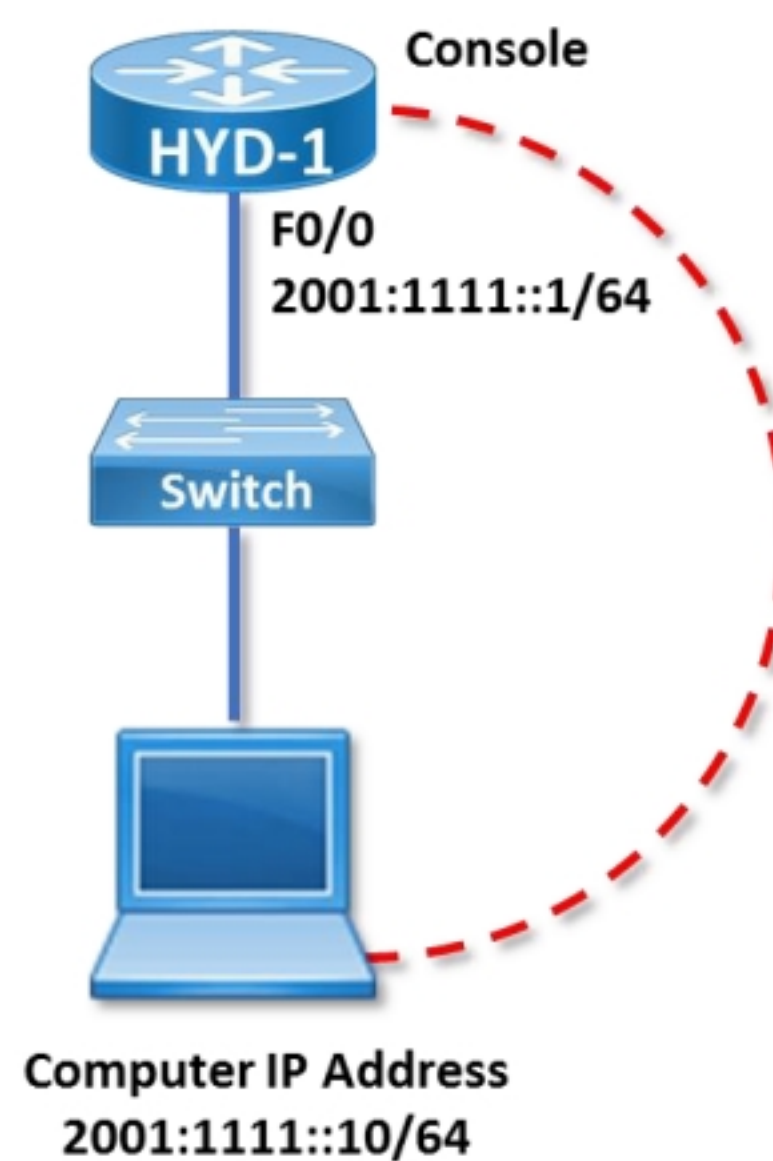
## LAB 4: INITIAL CONFIGURATION OF ROUTER – IPv6 NETWORK

### OBJECTIVE:

To get familiarized with Cisco IOS modes and configure a new Router with basic configuration i.e. assign IPv6 address on the interfaces and configure passwords etc.

### TOPOLOGY:

Setup Console and Ethernet connectivity for the lab as below :



### TASK:

- Establish console connectivity
- Access router via console with an emulation software
- Get to know Cisco IOS Modes and Show commands
- Configure Hostname and Interface IP address
- Configure Connectivity Passwords
- Configure Privilege Mode / Enable Password
- Verify configuration in RAM and NVRAM
- Saving configuration to the router
- Access the router via Telnet

### Establish console connectivity

Refer page no. 36 for how to establish console connectivity.

### Access router via console with an emulation software

Refer page no. 36 for accessing Router via console port .

### Get to know Cisco IOS Modes and Show commands

After the Router boots-up completely, (on a new Cisco Router) it enters setup mode as below:

```
--- System Configuration Dialog ---  
Would you like to enter the initial configuration dialog? [yes/no]: no  
Would you like to terminate autoinstall? [yes]: yes
```

If you choose “Yes”, IOS will prompt questions to gather the information to configure the Router, it is recommended to choose “no”, since we can configure the Router using IOS commands

```
Router >
```

#### **To navigate into Privilege mode/Executive Mode from User Mode and Vice-Versa**

```
Router>enable  
Router #
```

```
Router# disable  
Router >
```

#### **To view router IOS and hardware information**

```
Router # show version
```

```
Cisco IOS Software, 2800 Software (C2800NM-ADVENTERPRISEK9-M), Version 15.1  
Technical Support: http://www.cisco.com/techsupport  
Copyright (c) 1986-2015 by Cisco Systems, Inc.  
Compiled Tue 24-Mar-15 09:00 by prod_rel_team
```

```
ROM: System Bootstrap, Version 12.4(13r)T, RELEASE SOFTWARE (fc1)
```

```
Router uptime is 56 minutes  
System returned to ROM by reload at 08:19:55 UTC Sat Jul 9 2016  
System image file is "flash:c2800nm-adventerprisek9-mz.151-4.M10.bin"  
Last reload type: Normal Reload
```



This product contains cryptographic features and is subject to United States and local country laws governing import, export, transfer and use. Delivery of Cisco cryptographic products does not imply third-party authority to import, export, distribute or use encryption. Importers, exporters, distributors and users are responsible for compliance with U.S. and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at: <http://www.cisco.com/wwl/export/crypto/tool/stqrg.html>

If you require further assistance please contact us by sending email to [export@cisco.com](mailto:export@cisco.com).

```
Cisco 2811 (revision 1.0) with 249856K/12288K bytes of memory.
Processor board ID FHK1109F34X
2 FastEthernet interfaces
2 Serial(sync/async) interfaces
1 Virtual Private Network (VPN) Module
DRAM configuration is 64 bits wide with parity enabled.
239K bytes of non-volatile configuration memory.
125440K bytes of ATA CompactFlash (Read/Write)
```

License Info:  
License UDI:

```
-----
Device# PID SN
-----
*0 CISCO2811 FHK1109F34X
```

Configuration register is 0x2102

Router#

### To view router flash information

Router # **show flash**

```
-#- ---length--- -----date/time----- path
1          1 Jan 1 2016 13:54:52 +00:00 redirect.out
2 67926080 Sep 5 2015 14:59:38 +00:00 c2800nm-adventerprisek9-mz.151n
```

60235776 bytes available (67932160 bytes used)



**To view router current configuration (RAM)**

Router # **show running-config**

Current configuration : 1010 bytes

!

version 15.1

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

!

hostname Router

!

boot-start-marker

boot-end-marker

!

no aaa new-model

dot11 syslog

ip source-route!

ip cef

!

no ipv6 cef

!

multilink bundle-name authenticated!

!

crypto pki token default removal timeout 0

!

license udi pid CISCO2811 sn FHK1109F34X

!

redundancy

!

interface FastEthernet0/0

no ip address

shutdown

duplex auto

speed auto

!

interface FastEthernet0/1

no ip address

shutdown

duplex auto

speed auto

!

interface Serial0/0/0

no ip address

shutdown

no fair-queue

!

interface Serial0/0/1

no ip address

shutdown

!

ip forward-protocol nd

```
no ip http server
no ip http secure-server
!
control-plane
!
mgcp profile default
line con 0
line aux 0
line vty 0 4
login
transport input all
!
scheduler allocate 20000 1000
end
```

Router#

#### To view router startup configuration (NVRAM)

```
Router# show startup-config
startup-config is not present
```

#### To navigate into Global Configuration Mode

```
Router # configure terminal
Router (config) #
```

#### Configure Hostname and Interface IPv6 address

##### To change the Host Name of Router

```
Router (config) # hostname HYD-1
HYD-1 (config) #
```

##### To configure IPv6 address on Ethernet Interface (LAN interface)

```
HYD-1 (config) # interface FastEthernet 0/0
HYD-1 (config-if) # ipv6 address 2001:1111::1/64
HYD-1 (config-if) # no shutdown
HYD-1 (config-if) # exit
```

#### Configure Connectivity Passwords

##### To configure telnet password

```
HYD-1 (config) # line vty 0 4
HYD-1 (config-line) # password zoom
HYD-1 (config-line) # login
HYD-1 (config-line) # exit
```

**To configure console password**

```
HYD-1 (config) # line console 0
HYD-1 (config-line) # password ccna
HYD-1 (config-line) # login
HYD-1 (config-line) # exit
```

**To configure auxiliary password**

```
HYD-1 (config) # line aux 0
HYD-1 (config-line) # password cisco
HYD-1 (config-line) # login
HYD-1 (config-line) # exit
```

**Configure Privilege Mode / Enable Password****Configure privilege password**

```
HYD-1 (config) # enable password ccna
HYD-1 (config) # enable secret zoom
```

**Verify configuration in RAM and NVRAM****To View Router Current Configuration (RAM)**

```
HYD-1 # show running-config
```

```
Current configuration : 1241 bytes
!
Last configuration change at 08:37:39 UTC Sat Jul 9 2016
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname HYD-1
!
boot-start-marker
boot-end-marker
!
!
enable secret 5 $1$DMgk$ITC7TUZVwFn5969wEB2mw.
enable password ccna
!
no aaa new-model
!
dot11 syslog
ip source-route
!
ip cef
```



```
!  
multilink bundle-name authenticated  
crypto pki token default removal timeout 0  
!  
license udi pid CISCO2811 sn FHK1109F34X  
!  
redundancy  
!  
interface FastEthernet0/0  
ip address ipv6 address 2001:1111::1/64  
duplex auto  
speed auto  
!  
interface FastEthernet0/1  
no ip address  
shutdown  
duplex auto  
speed auto  
!  
interface Serial0/0/0  
no ip address  
shutdown  
no fair-queue  
clock rate 2000000  
!  
interface Serial0/0/1  
no ip address  
shutdown  
clock rate 2000000  
!  
ip forward-protocol nd  
no ip http server  
no ip http secure-server!  
control-plane  
!  
mgcp profile default  
!  
line con 0  
password ccna  
login  
line aux 0  
password cisco  
login  
line vty 0 4  
password zoom  
login  
transport input all  
!  
scheduler allocate 20000 1000  
end
```

**To View Router Startup Configuration (NVRAM)**

HYD-1 # **show startup-config**

startup-config is not present

**Saving configuration to the router****To save configuration on router**

HYD-1 # **copy running-config startup-config**

Destination filename [startup-config]?

Building configuration...

[OK]

HYD-1 #

**To view router startup configuration (NVRAM)**

HYD-1 # **show startup-config**

Current configuration : 1241 bytes

!

Last configuration change at 08:40:39 UTC Sat Jul 9 2016

version 15.1

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

!

hostname HYD-1

!

boot-start-marker

boot-end-marker

!

!

enable secret 5 \$1\$DMgk\$ITC7TUZVwFn5969wEB2mw.

enable password ccna

!

no aaa new-model

!

dot11 syslog

ip source-route

!

ip cef

!

no ipv6 cef

!

multilink bundle-name authenticated

crypto pki token default removal timeout 0

!

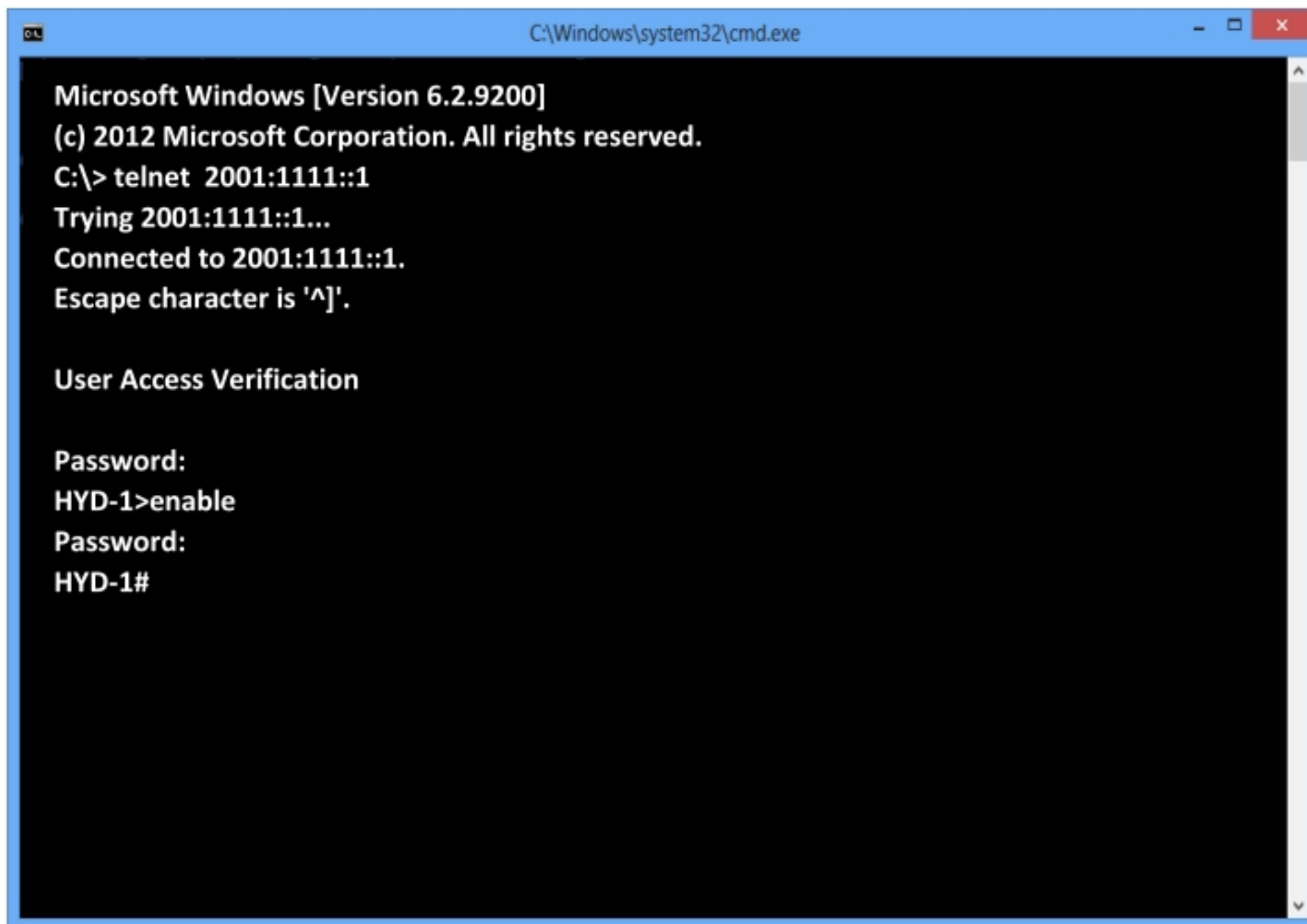
```
license udi pid CISCO2811 sn FHK1109F34X
!
redundancy
!
interface FastEthernet0/0
 ip address ipv6 address 2001:1111::1/64
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 no ip address
 shutdown
 no fair-queue
 clock rate 2000000
!
interface Serial0/0/1
 no ip address
 shutdown
 clock rate 2000000
!
ip forward-protocol nd
no ip http server
no ip http secure-server!
control-plane
!
mgcp profile default!
!
line con 0
 password ccna
 login
line aux 0
 password cisco
 login
line vty 0 4
 password zoom
 login
 transport input all
!
scheduler allocate 20000 1000
end
```



### Access the router via Telnet

- Accessing router via telnet by giving below command on a Windows or Linux computer.

**telnet 2001:1111::1**



```
C:\Windows\system32\cmd.exe

Microsoft Windows [Version 6.2.9200]
(c) 2012 Microsoft Corporation. All rights reserved.
C:\> telnet 2001:1111::1
Trying 2001:1111::1...
Connected to 2001:1111::1.
Escape character is '^'.

User Access Verification

Password:
HYD-1>enable
Password:
HYD-1#
```

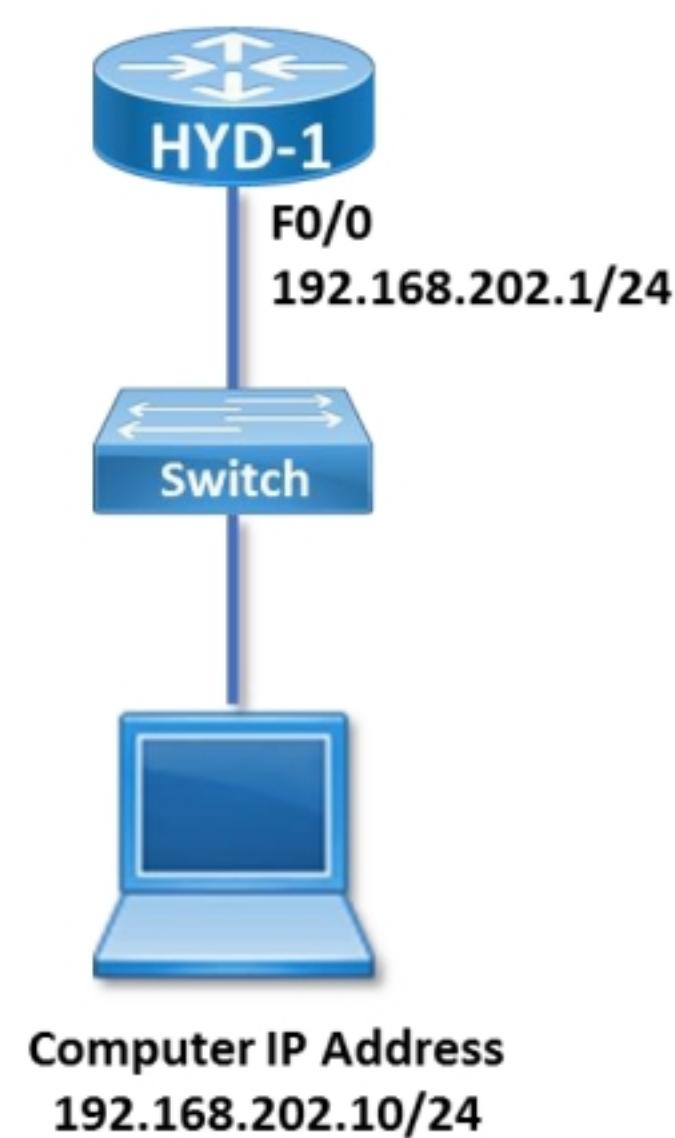
## LAB 5 : BASIC ROUTER SECURITY

### OBJECTIVE:

To enhance router security by encrypting all passwords, configure banners, exec-timeouts on router.

### TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



**Pre-requisite:** Initial configuration to be done on the router (LAB – 3)

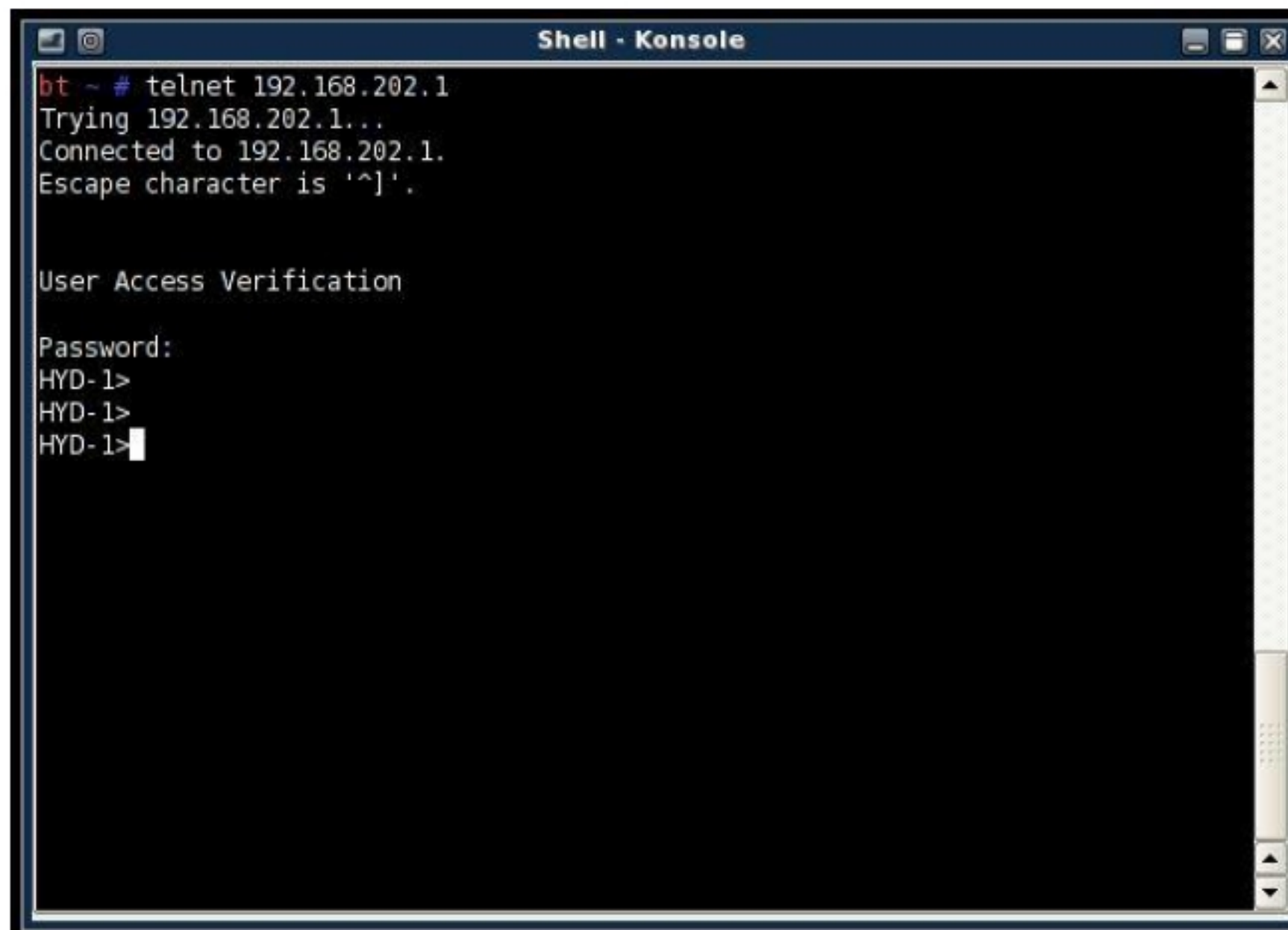
### TASKS:

- Access router via Telnet
- Encrypt all clear text passwords on the router.
- Configure Warning Banner
- Configure unattended (idle-timeout) session timeout for VTY access

## Access router via Telnet

- Access router via telnet by giving below command on a Windows or Linux computer.

**telnet 192.168.202.1**



## Encrypt all clear text passwords on the router

### Verify router's existing configuration

All password are in clear text except **enable secret password**

HYD-1 # **sh running-config**

Current configuration : 1241 bytes

!

Last configuration change at 08:37:39 UTC Sat Jul 9 2016

version 15.1

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

!

hostname HYD-1

!

boot-start-marker

boot-end-marker

!

enable secret 5 \$1\$DMgk\$ITC7TUZVwFn5969wEB2mw.

enable password ccna

!

no aaa new-model

!

dot11 syslog

ip source-route

!

ip cef



```
!  
multilink bundle-name authenticated  
crypto pki token default removal timeout 0  
!  
license udi pid CISCO2811 sn FHK1109F34X  
!  
redundancy  
!  
interface FastEthernet0/0  
ip address 192.168.202.1 255.255.255.0  
duplex auto  
speed auto  
!  
interface FastEthernet0/1  
no ip address  
shutdown  
duplex auto  
speed auto  
!  
interface Serial0/0/0  
no ip address  
shutdown  
no fair-queue  
!  
interface Serial0/0/1  
no ip address  
shutdown  
!  
ip forward-protocol nd  
no ip http server  
no ip http secure-server!  
control-plane  
!  
mgcp profile default  
!  
line con 0  
password ccna  
login  
line aux 0  
password cisco  
login  
line vty 0 4  
password zoom  
login  
transport input all  
!  
scheduler allocate 20000 1000  
end
```

HYD-1 #

**Encrypt all clear text passwords****HYD-1 # configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **service password-encryption**

HYD-1 (config) # **end**

**Verification:**

Now previously visible passwords are encrypted

**HYD-1 # sh running-config**

Building configuration...

Current configuration : 1241 bytes

!

Last configuration change at 08:37:39 UTC Sat Jul 9 2016

version 15.1

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

!

hostname HYD-1

!

boot-start-marker

boot-end-marker

!

!

enable secret 5 \$1\$DMgk\$ITC7TUZVwFn5969wEB2mw.

enable password 7 045802150C2E

!

no aaa new-model

!

dot11 syslog

ip source-route

!

ip cef

!

multilink bundle-name authenticated

crypto pki token default removal timeout 0

!

license udi pid CISCO2811 sn FHK1109F34X

!

redundancy

!

interface FastEthernet0/0

ip address 192.168.202.1 255.255.255.0

duplex auto

speed auto

!

interface FastEthernet0/1

no ip address

```

shutdown
duplex auto
speed auto
!
interface Serial0/0/0
no ip address
shutdown
no fair-queue
!
interface Serial0/0/1
no ip address
shutdown
!
ip forward-protocol nd
no ip http server
no ip http secure-server!
control-plane
!
mgcp profile default
!
line con 0
password 7 141411050D
login
line aux 0
password 7 030752180500
login
line vty 0 4
password 7 0109090B56
login
transport input all
!
scheduler allocate 20000 1000
end

```

HYD-1 #

### Configure Warning Banner

**Configure a warning message to display prior to login.**

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **banner motd \$**

Enter TEXT message. End with the character '\$'.

=====

**UNAUTHORISED ACCESS STRICTLY PROHIBITED AND**

**PROSECUTED TO THE FULL EXTENT OF THE LAW**

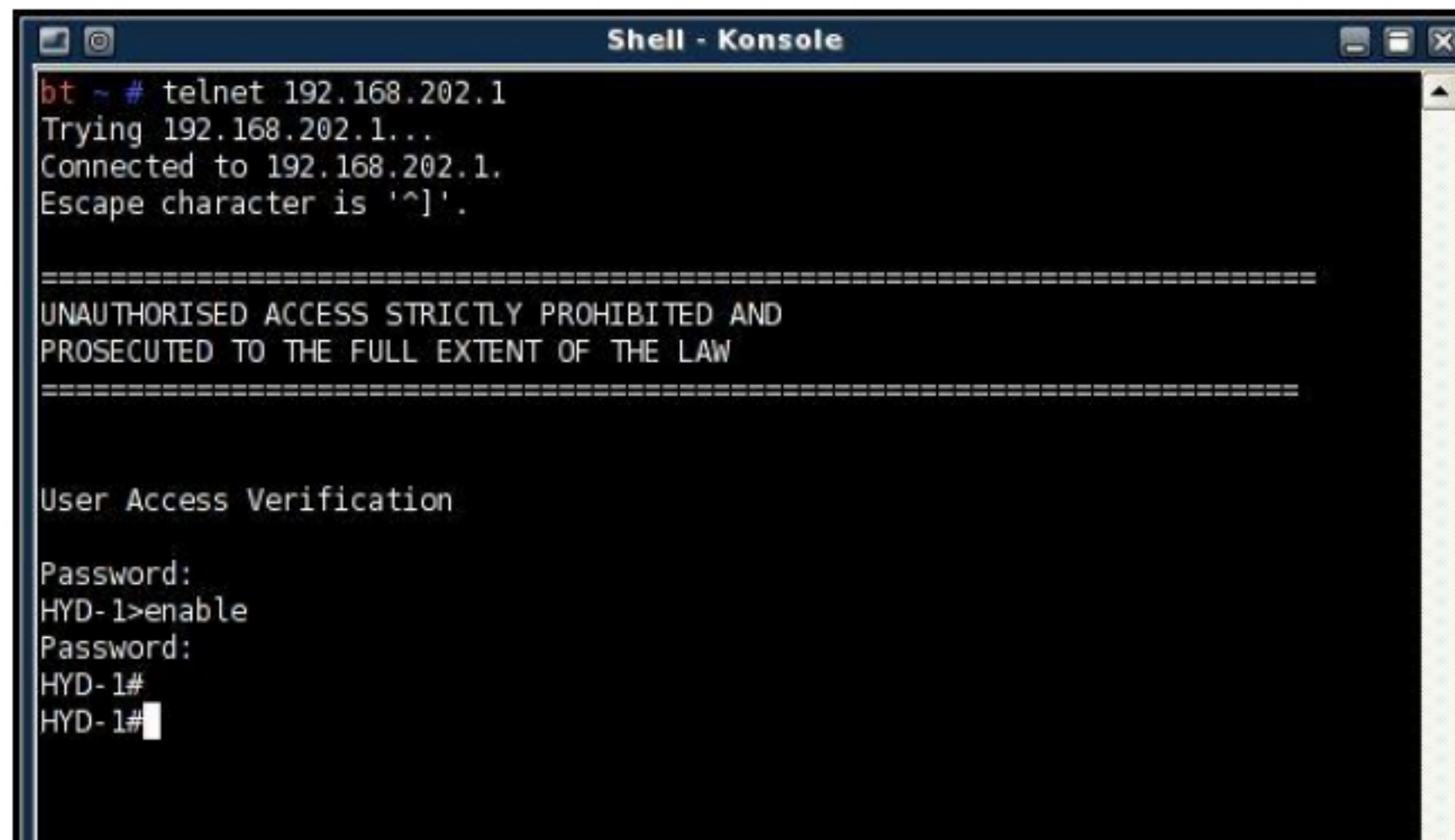
=====



### Verification:

Now open a new telnet session from your computer to the router to verify the banner configured.

i.e. **telnet 192.168.202.1**



```

Shell - Konsole
bt ~ # telnet 192.168.202.1
Trying 192.168.202.1...
Connected to 192.168.202.1.
Escape character is '^]'.

=====
UNAUTHORISED ACCESS STRICTLY PROHIBITED AND
PROSECUTED TO THE FULL EXTENT OF THE LAW
=====

User Access Verification

Password:
HYD-1>enable
Password:
HYD-1#
HYD-1#
  
```

### Configure unattended (idle-timeout) session timeout for VTY access

By default unattended session time-out is 10 minutes. We reducing the unattended session timeout to 1 minute 00 seconds.

**HYD-1 # configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

**HYD-1 (config) # line vty 0 4**

**HYD-1 (config-line) # exec-timeout 1 00**

**HYD-1 (config-line) # end**

### Verification:

Now open a new telnet session from your computer to the router (get into privilege mode) and leave the session open without performing any action or modification for 1 minute. Session will be automatically disconnected after the session time-out has been reached.



```

Shell - Konsole
bt ~ # telnet 192.168.202.1
Trying 192.168.202.1...
Connected to 192.168.202.1.
Escape character is '^]'.

=====
UNAUTHORISED ACCESS STRICTLY PROHIBITED AND
PROSECUTED TO THE FULL EXTENT OF THE LAW
=====

User Access Verification

Password:
HYD-1>
HYD-1>Connection closed by foreign host.
bt ~ #
bt ~ #
bt ~ #
bt ~ #
bt ~ #
bt ~ #
  
```

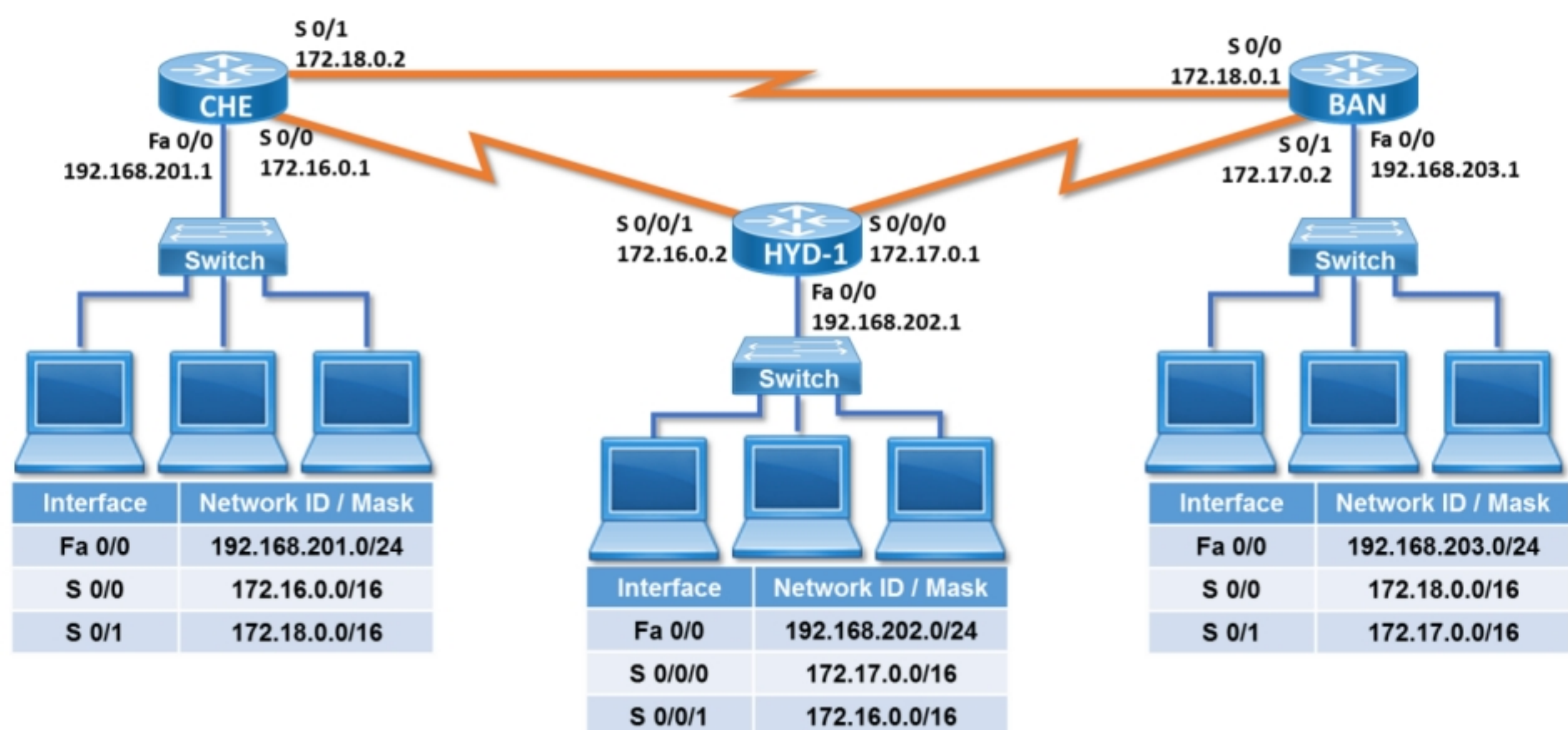
## LAB 6: WAN CONFIGURATION – SERIAL INTERFACE (IPv4)

### OBJECTIVE:

To configure and troubleshoot a Serial Interface.

### TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



### TASK:

- Identify Serial Interface as DCE or DTE
- Configure Serial Interface
- Verify Serial Interface Configuration
- Troubleshooting Serial Interface



## Identify Serial Interface as DCE or DTE

### Example - HYD-1

#### Identify DCE / DTE interface on HYD-1

HYD-1 # **show controllers serial 0/0/0**

Interface Serial0/0/0

Hardware is GT96K

DTE V.35

idb at 0x48C78680, driver data structure at 0x48C7FC80

wic\_info 0x48C802AC

Physical Port 1, SCC Num 1

!

<output omitted>

!

HYD-1 # **show controllers serial 0/0/1**

Interface Serial0/0/1

Hardware is GT96K

DCE V.35, no clock

idb at 0x48C82750, driver data structure at 0x48C89F94

wic\_info 0x48C8A5C0

Physical Port 0, SCC Num 0

!

<output omitted>

!

#### Verify Serial Interface existing status

HYD-1 # **show interface serial 0/0/0**

Serial0/0/0 is administratively down, line protocol is down

Hardware is GT96K Serial

MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,

reliability 255/255, txload 1/255, rxload 1/255

Encapsulation HDLC, loopback not set

Keepalive set (10 sec)

!

<output omitted>

!

HYD-1 # **show interface serial 0/0/1**

Serial0/0/1 is administratively down, line protocol is down

Hardware is GT96K Serial

MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,

reliability 255/255, txload 1/255, rxload 1/255

Encapsulation HDLC, loopback not set

Keepalive set (10 sec)

!

<output omitted>

!



**Verify HYD-1's existing configuration**

HYD-1 # **show running-config**

Building configuration...

Current configuration : 1210 bytes

hostname HYD-1

!

<output omitted>

!

interface FastEthernet0/0

ip address 192.168.202.1 255.255.255.0

duplex auto

speed auto

!

interface FastEthernet0/1

no ip address

shutdown

duplex auto

speed auto

!

interface Serial0/0/0

no ip address

shutdown

!

interface Serial0/0/1

no ip address

shutdown

!

<output omitted>

!

end

HYD-1 #

**Repeat the above commands on CHE and BAN routers.**

**Configure Serial Interface****CHE – Configuration**

CHE # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

CHE (config)# **interface serial 0/0**

CHE (config-if)# **ip address 172.16.0.1 255.255.0.0**

CHE (config-if)# **no shutdown**

CHE (config-if)# **clock rate 64000**

CHE (config-if)# **encapsulation hdlc**

CHE (config-if)# **exit**

CHE (config)#

```
CHE (config)# interface serial 0/1
CHE (config-if)# ip address 172.18.0.2 255.255.0.0
CHE (config-if)# no shutdown
CHE (config-if)# encapsulation hdlc
CHE (config-if)# exit
CHE (config)# exit
```

### **HYD-1 – Configuration**

```
HYD-1 # configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config)# interface serial 0/0/0
HYD-1 (config-if)# ip address 172.17.0.1 255.255.0.0
HYD-1 (config-if)# no shutdown
HYD-1 (config-if)# clock rate 64000
HYD-1 (config-if)# encapsulation hdlc
HYD-1 (config-if)# exit
HYD-1 (config)#
```

```
HYD-1 (config)# interface serial 0/0/1
HYD-1 (config-if)# ip address 172.16.0.2 255.255.0.0
HYD-1 (config-if)# no shutdown
HYD-1 (config-if)# encapsulation hdlc
HYD-1 (config-if)# exit
HYD-1 (config)# exit
```

### **BAN – Configuration**

```
BAN # configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
BAN (config)# interface serial 0/0
BAN (config-if)# ip address 172.18.0.1 255.255.0.0
BAN (config-if)# no shutdown
BAN (config-if)# clock rate 64000
BAN (config-if)# encapsulation hdlc
BAN (config-if)# exit
BAN (config)#
```

```
BAN (config)# interface serial 0/1
BAN (config-if)# ip address 172.17.0.2 255.255.0.0
BAN (config-if)# no shutdown
BAN (config-if)# encapsulation hdlc
BAN (config-if)# exit
BAN (config)# exit
```



## Verify Serial Interface Configuration

### CHE – Verification

CHE # **show interface serial 0/0**

Serial0/0 is up, line protocol is up

Hardware is PowerQUICC Serial

Internet address is 172.16.0.1/16

MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,  
reliability 255/255, txload 1/255, rxload 1/255

Encapsulation HDLC, loopback not set

Keepalive set (10 sec)

!

<output omitted>

!

CHE# **show interface serial 0/1**

Serial0/1 is up, line protocol is up

Hardware is PowerQUICC Serial

Internet address is 172.18.0.2/16

MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,  
reliability 255/255, txload 1/255, rxload 1/255

Encapsulation HDLC, loopback not set

Keepalive set (10 sec)

!

<output omitted>

!

### HYD-1 – Verification:

HYD-1 # **show interface serial 0/0/0**

Serial0/0/0 is up, line protocol is up

Hardware is GT96K Serial

Internet address is 172.17.0.1/16

MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,  
reliability 255/255, txload 1/255, rxload 1/255

Encapsulation HDLC, loopback not set

Keepalive set (10 sec)

!

<output omitted>

HYD-1 # **show interface serial 0/0/1**

Serial0/0/1 is up, line protocol is up

Hardware is GT96K Serial

Internet address is 172.16.0.2/16

MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,  
reliability 255/255, txload 1/255, rxload 1/255

Encapsulation HDLC, loopback not set

Keepalive set (10 sec)

!

<output omitted>



### **BAN – Verification:**

BAN # **show interface serial 0/0**

Serial0/0 is up, line protocol is up

Hardware is PowerQUICC Serial

Internet address is 172.18.0.1/16

MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,

reliability 255/255, txload 1/255, rxload 1/255

Encapsulation HDLC, loopback not set

Keepalive set (10 sec)

!

<output omitted>

!

BAN # **show interface serial 0/1**

Serial0/1 is up, line protocol is up

Hardware is PowerQUICC Serial

Internet address is 172.17.0.2/16

MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,

reliability 255/255, txload 1/255, rxload 1/255

Encapsulation HDLC, loopback not set

Keepalive set (10 sec)

!

<output omitted>

!

### **Troubleshooting Serial Interface**

From the output, the first line indicates the status of the Serial interface. There are 4 possible states:

**1. Serial 0/0 is up , line protocol is up**

Layer 1 and Layer 2 Connectivity and configuration is fine

**2. Serial 0/0 is administratively down, line protocol is down**

‘No Shutdown’ has to be given on the local Router’s Serial interface

**3. Serial 0/0 is up, line protocol is down**

Encapsulation mismatch or clock rate has not been given on the DCE interface or Lease Line problem

**4. Serial 0/0 is down, line protocol is down**

Problem with the v.35 cable, CSU/DSU or ‘no shutdown’ has not been given on the remote Router

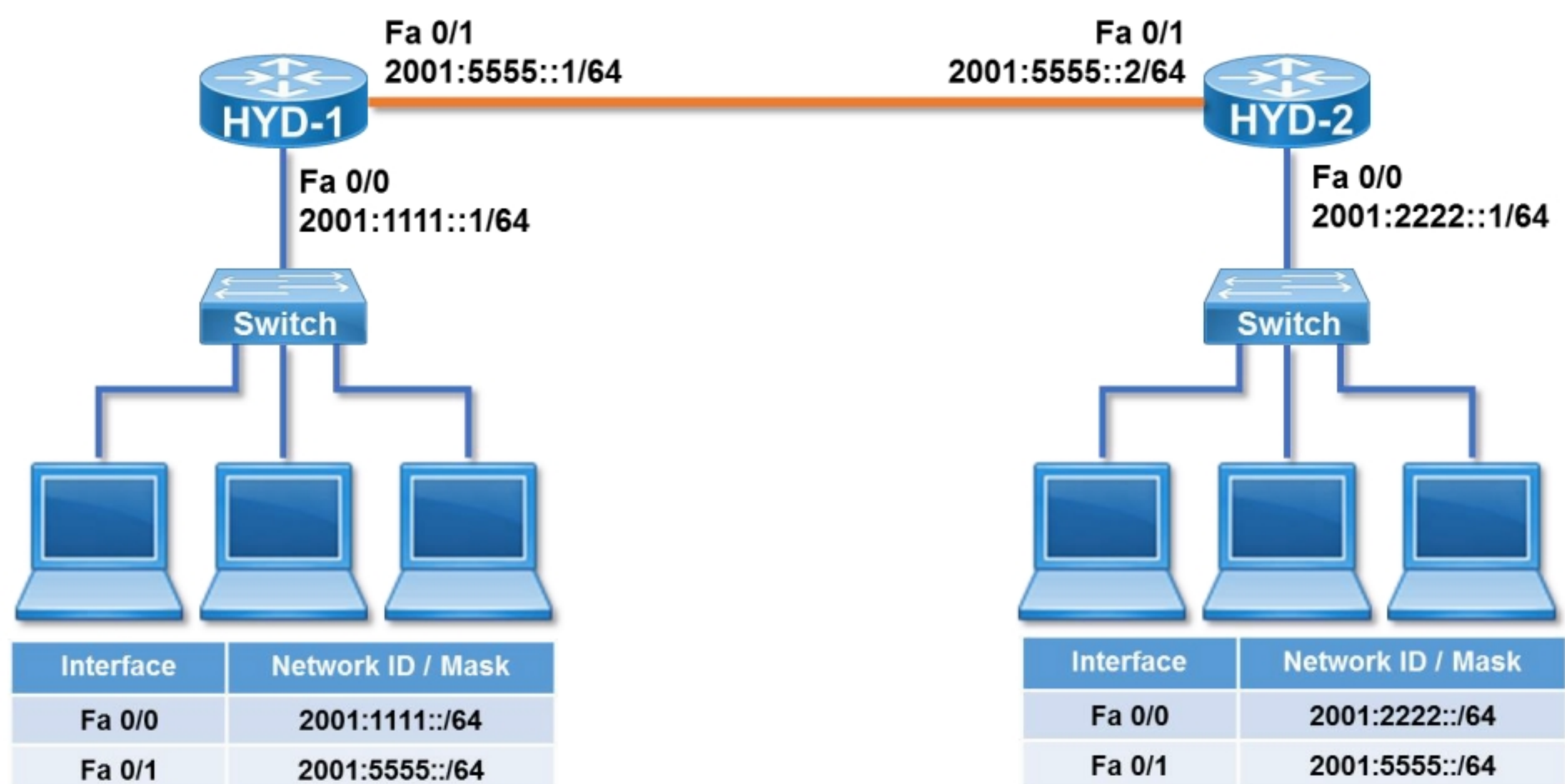
## LAB 7: WAN CONFIGURATION – ETHERNET INTERFACE (IPv6)

### OBJECTIVE:

To configure and troubleshoot an Ethernet Interface.

### TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



### TASK:

- Verify Ethernet Interface existing status
- Configure Ethernet Interface with IPv6 address
- Verify IPv6 Address Configuration on Ethernet Interface
- Troubleshooting Ethernet Interface



**Verify Ethernet Interface existing status**

HYD-1 # **show interface fastethernet 0/1**

FastEthernet0/ is administratively down, line protocol is down

Hardware is MV96340 Ethernet, address is 0017.9460.c209 (bia 0017.9460.c209)

MTU 1500 bytes, BW 100000 Kbit/sec, DLY 100 usec,

reliability 255/255, txload 1/255, rxload 1/255

Encapsulation ARPA, loopback not set

Keepalive set (10 sec)

Full-duplex, 100Mb/s, 100BaseTX/FX

!

<output omitted>

!

**Verify HYD-1's existing configuration**

HYD-1 # **show running-config**

Building configuration...

Current configuration : 1210 bytes

hostname HYD-1

!

<output omitted>

!

interface FastEthernet0/0

ip address 192.168.202.1 255.255.255.0

ip address ipv6 address 2001:1111::1/64

duplex auto

speed auto

!

interface FastEthernet0/1

no ip address

shutdown

duplex auto

speed auto

!

interface Serial0/0/0

ip address 172.17.0.1 255.255.0.0

!

interface Serial0/0/1

ip address 172.16.0.2 255.255.0.0

!

<output omitted>

!

end

HYD-1 #

**Repeat the above commands on HYD-2 router.**



## Configure Ethernet Interface with IPv6 address

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config)# **interface fastethernet 0/1**

HYD-1 (config-if)# **ipv6 address 2001:5555::1/64**

HYD-1 (config-if)# **no shutdown**

HYD-1 (config-if)# **exit**

HYD-1 (config)#

### HYD-2 – Configuration

HYD-2 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-2 (config)# **interface fastethernet 0/1**

HYD-2 (config-if)# **ipv6 address 2001:5555::2/64**

HYD-2 (config-if)# **no shutdown**

HYD-2 (config-if)# **exit**

HYD-2 (config)#

## Verify IPv6 Address Configuration on Ethernet Interface

### HYD-1 – Verification

HYD-1 # **show ipv6 interface fastethernet 0/1**

FastEthernet0/1 is up, line protocol is up

IPv6 is enabled, link-local address is FE80::21B:D4FF:FE3D:B279

Global unicast address(es):

2001:5555::1, subnet is 2001:5555::/64

Joined group address(es):

FF02::1

FF02::2

FF02::1:FF00:1

FF02::1:FF3D:B279

MTU is 1500 bytes

ICMP error messages limited to one every 100 milliseconds

ICMP redirects are enabled

ND DAD is enabled, number of DAD attempts: 1

ND reachable time is 30000 milliseconds

Default router is FE80::217:94FF:FE60:C209 on FastEthernet0/1

HYD-1#

## HYD-2 – Verification

HYD-2 # **show ipv6 interface fastethernet 0/1**

FastEthernet0/1 is up, line protocol is up

IPv6 is enabled, link-local address is FE80::217:94FF:FE60:C209

Global unicast address(es):

2001:5555::2, subnet is 2001:5555::/64

Joined group address(es):

FF02::1

FF02::2

FF02::1:FF00:2

FF02::1:FF3D:B279

MTU is 1500 bytes

ICMP error messages limited to one every 100 milliseconds

ICMP redirects are enabled

ND DAD is enabled, number of DAD attempts: 1

ND reachable time is 30000 milliseconds

Default router is FE80::21B:D4FF:FE3D:B279 on FastEthernet0/1

HYD-2#

## Troubleshooting Ethernet Interface

From the output, the first line indicates the status of the Ethernet interface. There are 4 possible states:

**1. Fastethernet 0/0 is up , line protocol is up**

Layer 1 and Layer 2 Connectivity and configuration is fine

**2. Fastethernet 0/0 is administratively down, line protocol is down**

‘No Shutdown’ has to be given on the local ethernet interface

**3. Fastethernet 0/0 is up, line protocol is down**

Speed & Duplex Mismatch or ‘No Shutdown’ has not been given on the remote device ethernet interface.

**4. Fastethernet 0/0 is down, line protocol is down**

Layer 1 problem - No device attached or faulty cable.



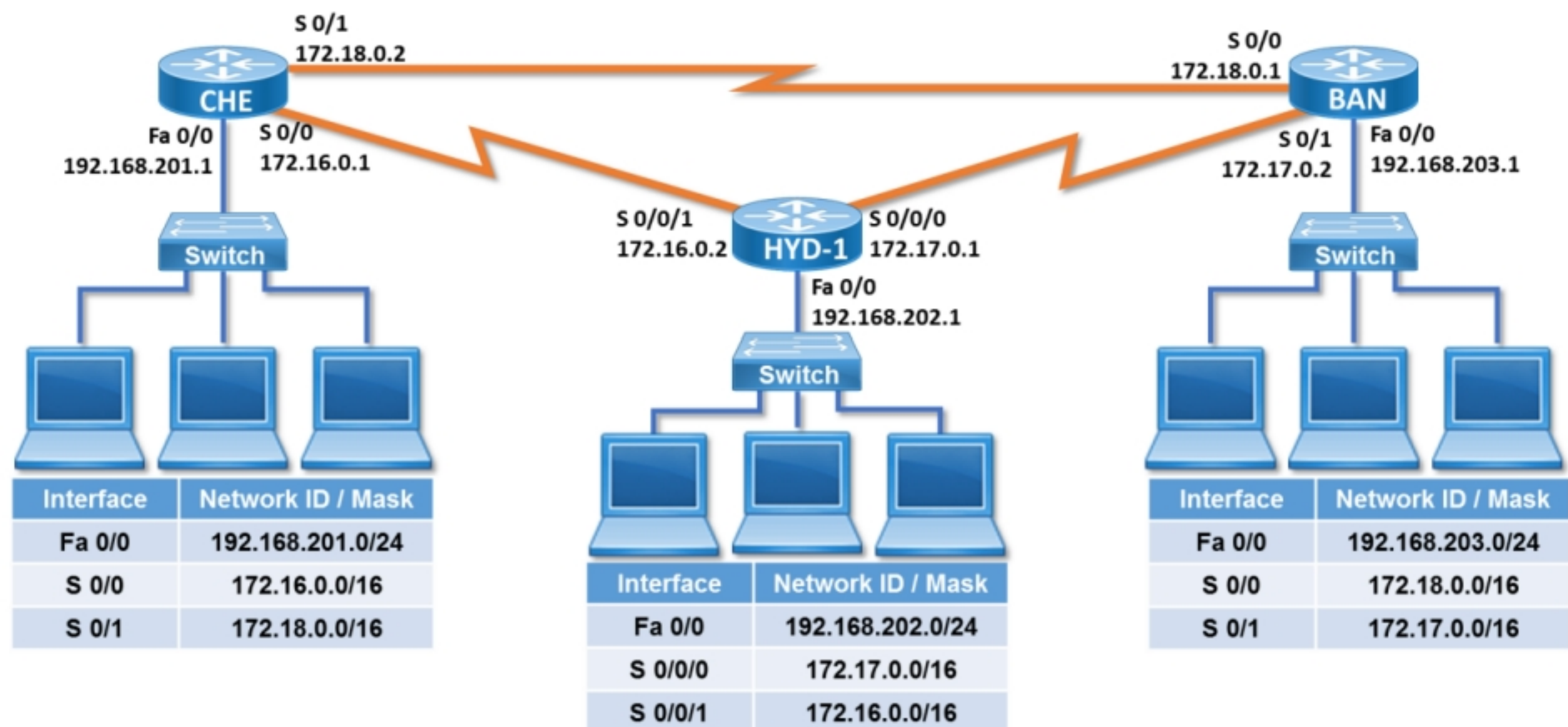
## LAB 8: STATIC ROUTING ON IPv4 NETWORK

### OBJECTIVE:

To configure Static Routing on IPv4 Network for enabling communication between different networks connected to different routers. To set up static routes on CHE, HYD-1, BAN to connect to each other's local networks.

### TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



**Pre-requisite: WAN Interface configuration to be done on the router (LAB – 6)**

### TASK:

- Enabling IPv4 Routing
- Verify IPv4 Routing Table
- Configure Static Routing on IPv4 Network
- Verify Static Routing on IPv4 Network
- Verify communication between the IPv4 networks.



## Enabling IPv4 Routing

### CHE – Configuration

CHE # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

CHE (config) # **ip routing**

CHE (config) #

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ip routing**

HYD-1 (config) #

### BAN – Configuration

BAN # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

BAN (config) # **ip routing**

BAN (config) #

**Note :** Once routing is enabled the directly connected networks are automatically added into the routing information table. “C” represents directly connected networks. The IPv4 Network is learnt through the local Interface of the router.

## Verify IPv4 Routing Table

### CHE – Verification:

CHE # **show ip route**

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area

\* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is not set

C 172.16.0.0/16 is directly connected, Serial0/0

C 172.18.0.0/16 is directly connected, Serial0/1

C 192.168.201.0/24 is directly connected, FastEthernet0/0

CHE #

**HYD-1 – Verification:****HYD-1 # show ip route**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, \* - candidate default, U - per-user static route  
o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP  
+ - replicated route, % - next hop override

Gateway of last resort is not set

```
192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.202.0/24 is directly connected, FastEthernet0/0
L 10.0.0.1/32 is directly connected, FastEthernet0/0
172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.16.0.0/16 is directly connected, Serial0/0/1
L 172.16.0.2/32 is directly connected, Serial0/0/1
172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.17.0.0/16 is directly connected, Serial0/0/0
L 172.17.0.1/32 is directly connected, Serial0/0/0
HYD-1 #
```

**BAN – Verification:****BAN # show ip route**

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, \* - candidate default, U - per-user static route  
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

```
C 172.17.0.0/16 is directly connected, Serial0/1
C 172.18.0.0/16 is directly connected, Serial0/0
C 192.168.203.0/24 is directly connected, FastEthernet0/0
BAN #
```



## Configure Static Routing on IPv4 Network

### CHE – Configuration

CHE # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

CHE (config) # **ip route 192.168.202.0 255.255.255.0 172.16.0.2**

CHE (config) # **ip route 192.168.203.0 255.255.255.0 172.18.0.1**

CHE (config) # **exit**

CHE (config) #

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ip route 192.168.201.0 255.255.255.0 172.16.0.1**

HYD-1 (config) # **ip route 192.168.203.0 255.255.255.0 172.17.0.2**

HYD-1 (config) # **exit**

HYD-1 (config) #

### BAN – Configuration

BAN # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

BAN (config) # **ip route 192.168.202.0 255.255.255.0 172.17.0.1**

BAN (config) # **ip route 192.168.201.0 255.255.255.0 172.18.0.2**

BAN (config) # **exit**

BAN (config) #

## Verify Static Routing on IPv4 Network

Once Static routing is enabled, the IPv4 Networks defined with the **Static routing command** are added into the routing information table. “S” represents **Static route**.

### CHE – Verification:

CHE # **show ip route**

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area

\* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is not set

C 172.16.0.0/16 is directly connected, Serial0/0

C 172.18.0.0/16 is directly connected, Serial0/1

S 192.168.202.0/24 [1/0] via 172.16.0.2



```
C 192.168.201.0/24 is directly connected, FastEthernet0/0
S 192.168.203.0/24 [1/0] via 172.18.0.1
CHE #
```

### **HYD-1 – Verification:**

#### **HYD-1 # show ip route**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
 E1 - OSPF external type 1, E2 - OSPF external type 2  
 i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
 ia - IS-IS inter area, \* - candidate default, U - per-user static route  
 o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP  
 + - replicated route, % - next hop override

Gateway of last resort is not set

```
192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.202.0/24 is directly connected, FastEthernet0/0
L 192.168.202.1/32 is directly connected, FastEthernet0/0
172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.16.0.0/16 is directly connected, Serial0/0/1
L 172.16.0.2/32 is directly connected, Serial0/0/1
172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.17.0.0/16 is directly connected, Serial0/0/0
L 172.17.0.1/32 is directly connected, Serial0/0/0
S 192.168.201.0/24 [1/0] via 172.16.0.1
S 192.168.203.0/24 [1/0] via 172.17.0.2
HYD-1 #
```

### **BAN – Verification:**

#### **BAN # show ip route**

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
 E1 - OSPF external type 1, E2 - OSPF external type 2  
 i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
 ia - IS-IS inter area, \* - candidate default, U - per-user static route  
 o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

```
C 172.17.0.0/16 is directly connected, Serial0/1
C 172.18.0.0/16 is directly connected, Serial0/0
S 192.168.202.0/24 [1/0] via 172.17.0.1
S 192.168.201.0/24 [1/0] via 172.18.0.2
C 192.168.203.0/24 is directly connected, FastEthernet0/0
BAN #
```

## Verify communication between the IPv4 networks

### Verification from a Computer in HYD-1 Network

**ping 192.168.201.10**

```
PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.  
64 bytes from 192.168.201.10: icmp_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.201.10: icmp_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.201.10: icmp_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp_seq=4 ttl=62 time=24.0 ms
```

**ping 192.168.203.10**

```
PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms
```

**Repeat the above ping verification from a computer in CHE and BAN Network.**

### From a Computer in HYD-1 Network trace communication path to a Computer in CHE Network

```
tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)  
traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets  
 1  192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms  
 2  172.16.0.1 (172.16.0.1)  2.295 ms  2.156 ms  2.209 ms  
 3  192.168.201.10 (192.168.202.10)  3.295 ms  3.156 ms  3.209 ms
```

### From a Computer in HYD-1 Network trace communication path to a Computer in BAN Network

```
tracert 192.168.203.10 (Windows) or traceroute 192.168.203.10 (Linux)  
traceroute to 192.168.203.10 (192.168.203.10), 30 hops max, 38 byte packets  
 1  192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms  
 2  172.17.0.2 (172.17.0.2)  2.295 ms  2.156 ms  2.209 ms  
 3  192.168.203.10 (192.168.203.10)  3.295 ms  3.156 ms  3.209 ms
```

**Repeat the above trace communication path from a computer in CHE and BAN Network.**



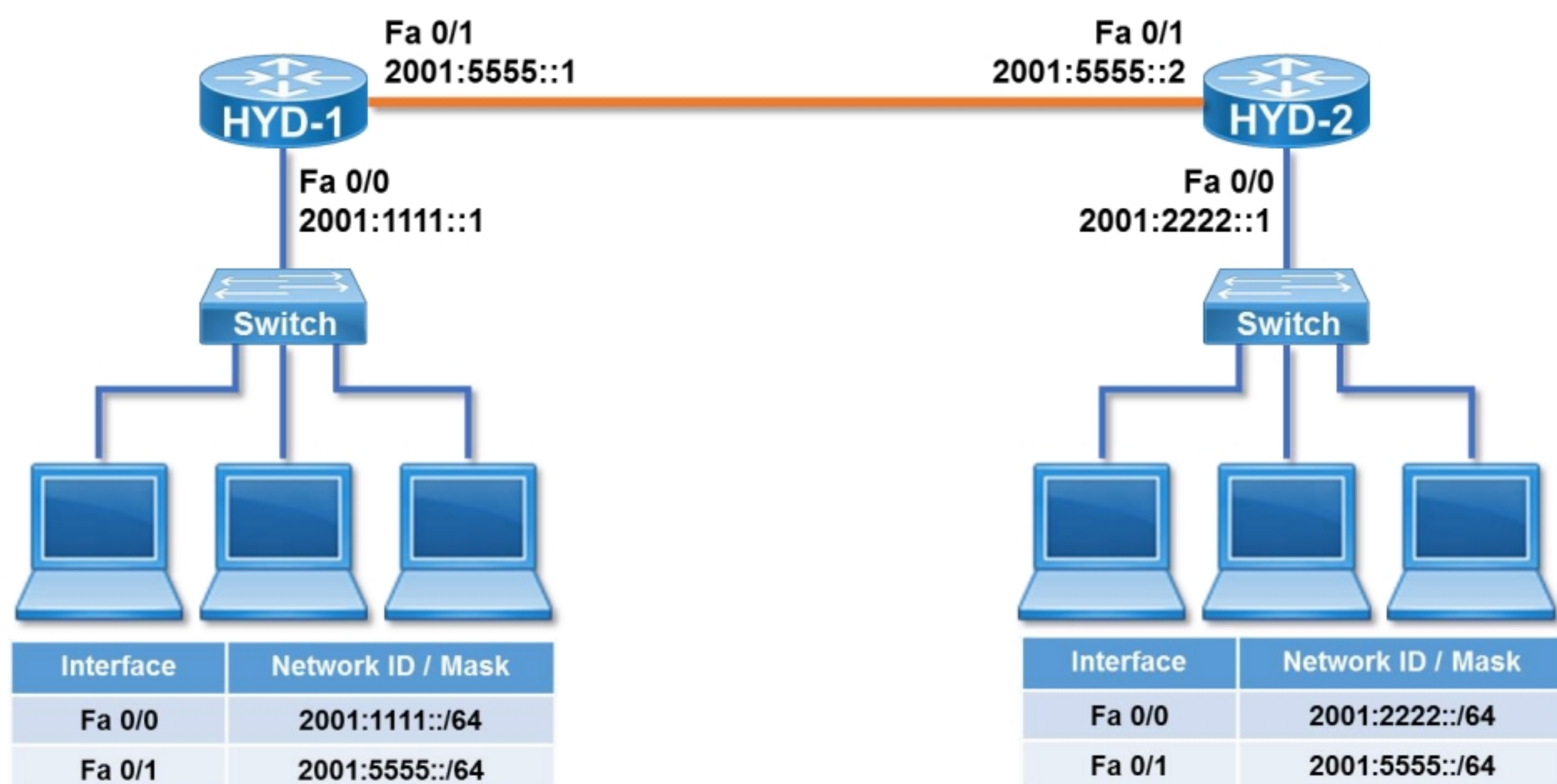
## LAB 9: STATIC ROUTING ON IPv6 NETWORK

### OBJECTIVE:

To configure Static Routing on IPv6 Network for enabling communication between different networks connected to different routers. To set up static routes on HYD-1 and HYD-2 to connect to each other's local networks.

### TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



**Pre-requisite:** WAN Interface configuration to be done on the router (LAB – 7)

### TASK:

- Enabling IPv6 Routing
- Verify IPv6 Routing Table
- Configure Static Routing on IPv6 Network
- Verify Static Routing on IPv6 Network
- Verify communication between the IPv6 networks.



## Enabling IPv6 Routing

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ipv6 unicast-routing**

HYD-1 (config) #

### HYD-2 – Configuration

HYD-2 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-2 (config) # **ipv6 unicast-routing**

HYD-2 (config) #

**Note :** Once routing is enabled the directly connected networks are automatically added into the routing information table. "C" represents directly connected networks. The IPv6 Network is learnt through the local Interface of the router.

## Verify IPv6 Routing Table

### HYD-1 – Verification:

HYD-1# **show ipv6 route**

IPv6 Routing Table - default - 5 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP

I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary

D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery

I - LISP

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2

```
C 2001:1111::/64 [0/0]
  via FastEthernet0/0, directly connected
L 2001:1111::1/128 [0/0]
  via FastEthernet0/0, receive
C 2001:5555::/64 [0/0]
  via FastEthernet0/1, directly connected
L 2001:5555::1/128 [0/0]
  via FastEthernet0/1, receive
L FF00::/8 [0/0]
  via Null0, receive
HYD-1#
```

## HYD-2 – Verification:

HYD-1 # **show ipv6 route**

IPv6 Routing Table - default - 5 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP

I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary

D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery

I - LISP

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2

C 2001:2222::/64 [0/0]  
via FastEthernet0/0, directly connected

L 2001:2222::1/128 [0/0]  
via FastEthernet0/0, receive

C 2001:5555::/64 [0/0]  
via FastEthernet0/1, directly connected

L 2001:5555::2/128 [0/0]  
via FastEthernet0/1, receive

L FF00::/8 [0/0]  
via Null0, receive

HYD-2#

## Configure Static Routing on IPv6 Network

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ipv6 route 2001:2222::/64 2001:5555::2**

HYD-1 (config) # **exit**

HYD-1 (config) #

### HYD-2 – Configuration

HYD-2 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-2 (config) # **ipv6 route 2001:1111::/64 2001:5555::1**

HYD-2 (config) # **exit**

HYD-2 (config) #



## Verify Static Routing on IPv6 Network

Once Static routing is enabled, the IPv6 Networks defined with the **Static routing command** are added into the routing information table. "**S**" represents **Static route**.

### HYD-1 – Verification:

#### HYD-1 # **show ip route**

IPv6 Routing Table - default - 6 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP

I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary

D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2

```
C 2001:1111::/64 [0/0]
  via FastEthernet0/0, directly connected
L 2001:1111::1/128 [0/0]
  via FastEthernet0/0, receive
S 2001:2222::/64 [1/0]
  via 2001:5555::2
C 2001:5555::/64 [0/0]
  via FastEthernet0/1, directly connected
L 2001:5555::1/128 [0/0]
  via FastEthernet0/1, receive
L FF00::/8 [0/0]
  via Null0, receive
HYD-1#
```

### HYD-2 – Verification:

#### HYD-2 # **show ipv6 route**

IPv6 Routing Table - default - 6 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP

I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary

D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2

```
S 2001:1111::/64 [1/0]
  via 2001:5555::1
C 2001:2222::/64 [0/0]
  via FastEthernet0/0, directly connected
L 2001:2222::1/128 [0/0]
  via FastEthernet0/0, receive
C 2001:5555::/64 [0/0]
  via FastEthernet0/1, directly connected
L 2001:5555::2/128 [0/0]
  via FastEthernet0/1, receive
L FF00::/8 [0/0]
  via Null0, receive
HYD-2#
```



## Verify communication between the IPv6 networks

### Verification from a Computer in HYD-1 Network

**ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)**

```
PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=62 time=0.336 ms
```

### Verification from a Computer in HYD-2 Network

**ping 2001:1111::10 (Windows) or ping6 2001:1111::10 (Linux)**

```
PING 2001:1111::10(2001:1111::10) 56 data bytes
64 bytes from 2001:1111::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:1111::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:1111::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:1111::10: icmp_seq=4 ttl=62 time=0.336 ms
```

### From a Computer in HYD-1 Network trace communication path to a Computer in HYD-2 Network

**tracert 2001:2222::10 (Windows) or traceroute6 2001:2222::10 (Linux)**

```
traceroute to 2001:2222::10 (2001:2222::10), 30 hops max, 80 byte packets
 1  2001:1111::1 (2001:1111::1)  2.825 ms  3.239 ms  3.665 ms
 2  2001:5555::2 (2001:5555::2)  9.086 ms  9.393 ms  9.642 ms
 3  2001:2222::10 (2001:2222::10)  9.781 ms  10.474 ms  10.720 ms
```

### From a Computer in HYD-2 Network trace communication path to a Computer in HYD-1 Network

**tracert 2001:1111::10 (Windows) or traceroute6 2001:1111::10 (Linux)**

```
traceroute to 2001:1111::10 (2001:1111::10), 30 hops max, 80 byte packets
 1  2001:2222::1 (2001:2222::1)  1.071 ms  1.152 ms  1.238 ms
 2  2001:5555::1 (2001:5555::1)  4.303 ms  4.930 ms  5.419 ms
 3  2001:1111::10 (2001:1111::10)  10.832 ms  11.444 ms  11.541 ms
```

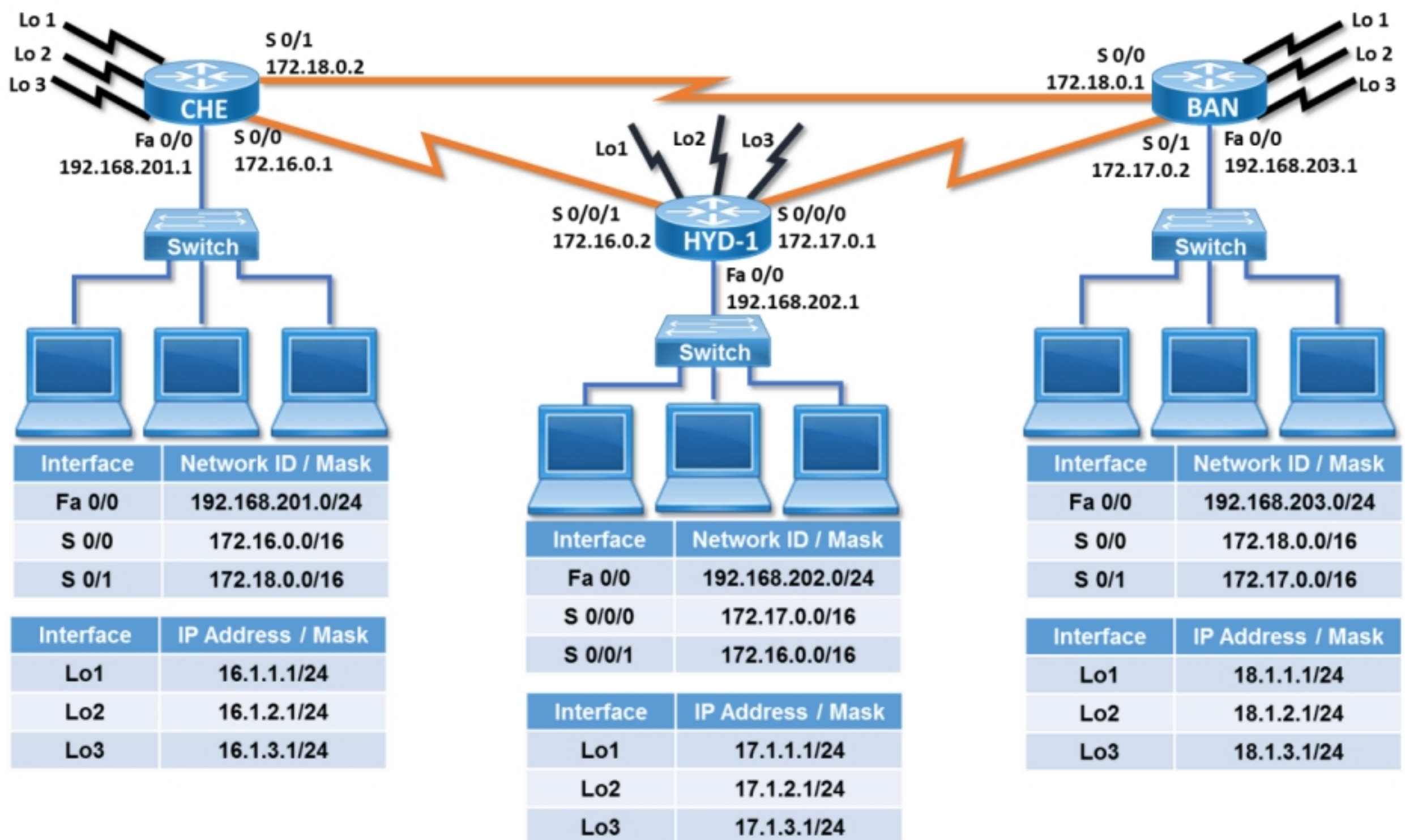
## LAB 10: RIP ON IPv4 NETWORK

### OBJECTIVE:

To configure RIP routing for communicating between different IPv4 networks on different routers.

### TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



**Pre-requisite: WAN Interface configuration to be done on the router (LAB – 6)**

### TASK:

- Configure Loopback Interface
- Verify Loopback Interface
- Configure RIP Routing on IPv4 network
- Verify RIP Routing on IPv4 network
- Verify Communication between the IPv4 networks
- Verify RIP protocol default settings
- Verify RIP Update Packets
- Changing RIP Timers
- Enabling Passive Interface on RIP
- Verify RIP Database
- Disabling RIP Auto Summary



## **Configure Loopback Interface**

Configure Loopback interface according to Lab Topology

### **CHE – Configuration**

CHE # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

CHE (config)# **interface Lo 1**

CHE (config-if)# **ip address 16.1.1.1 255.255.255.0**

CHE (config)# **interface Lo 2**

CHE (config-if)# **ip address 16.1.2.1 255.255.255.0**

CHE (config)# **interface Lo 3**

CHE (config-if)# **ip address 16.1.3.1 255.255.255.0**

CHE (config-if)# **exit**

### **HYD-1 – Configuration**

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config)# **interface Lo 1**

HYD-1 (config-if)# **ip address 17.1.1.1 255.255.255.0**

HYD-1 (config)# **interface Lo 2**

HYD-1 (config-if)# **ip address 17.1.2.1 255.255.255.0**

HYD-1 (config)# **interface Lo 3**

HYD-1 (config-if)# **ip address 17.1.3.1 255.255.255.0**

HYD-1 (config-if)# **exit**

### **BAN – Configuration**

BAN # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

BAN (config)# **interface Lo 1**

BAN (config-if)# **ip address 18.1.1.1 255.255.255.0**

BAN (config)# **interface Lo 2**

BAN (config-if)# **ip address 18.1.2.1 255.255.255.0**

BAN (config)# **interface Lo 3**

BAN (config-if)# **ip address 18.1.3.1 255.255.255.0**

BAN (config-if)# **exit**



## Verify Loopback Interface

### CHE – Verification:

#### CHE # show ip interface brief

| Interface       | IP-Address    | OK? | Method | Status | Protocol |
|-----------------|---------------|-----|--------|--------|----------|
| FastEthernet0/0 | 192.168.201.1 | YES | NVRAM  | up     | up       |
| Serial0/0       | 172.16.0.1    | YES | NVRAM  | up     | up       |
| Serial0/1       | 172.18.0.2    | YES | NVRAM  | up     | up       |
| Loopback1       | 16.1.1.1      | YES | manual | up     | up       |
| Loopback2       | 16.1.2.1      | YES | manual | up     | up       |
| Loopback3       | 16.1.3.1      | YES | manual | up     | up       |

### HYD-1 – Verification:

#### HYD-1# show ip interface brief

| Interface       | IP-Address    | OK? | Method | Status                | Protocol |
|-----------------|---------------|-----|--------|-----------------------|----------|
| FastEthernet0/0 | 192.168.202.1 | YES | NVRAM  | up                    | up       |
| FastEthernet0/1 | unassigned    | YES | NVRAM  | administratively down | down     |
| Serial0/0/0     | 172.17.0.1    | YES | manual | up                    | up       |
| Serial0/0/1     | 172.16.0.2    | YES | manual | up                    | up       |
| Loopback1       | 17.1.1.1      | YES | manual | up                    | up       |
| Loopback2       | 17.1.2.1      | YES | manual | up                    | up       |
| Loopback3       | 17.1.3.1      | YES | manual | up                    | up       |

### BAN – Verification:

#### HYD-1# show ip interface brief

| Interface       | IP-Address    | OK? | Method | Status                | Protocol |
|-----------------|---------------|-----|--------|-----------------------|----------|
| FastEthernet0/0 | 192.168.203.1 | YES | NVRAM  | up                    | up       |
| Serial0/0       | 172.18.0.1    | YES | NVRAM  | up                    | up       |
| FastEthernet0/1 | unassigned    | YES | NVRAM  | administratively down | down     |
| Serial0/1       | 172.17.0.2    | YES | NVRAM  | up                    | up       |
| Loopback1       | 18.1.1.1      | YES | manual | up                    | up       |
| Loopback2       | 18.1.2.1      | YES | manual | up                    | up       |
| Loopback3       | 18.1.3.1      | YES | manual | up                    | up       |

## Configure RIP Routing on IPv4 network

### CHE – Configuration

CHE # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

CHE (config) # **ip routing**

CHE (config) # **router rip**

CHE (config-router) # **version 2**

CHE (config-router) # **network 192.168.201.0**

CHE (config-router) # **network 172.16.0.0**

CHE (config-router) # **network 172.18.0.0**

CHE (config-router) # **network 16.0.0.0**

CHE (config-router) # **end**

CHE #

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ip routing**

HYD-1 (config) # **router rip**

HYD-1 (config-router) # **version 2**

HYD-1 (config-router) # **network 192.168.202.0**

HYD-1 (config-router) # **network 172.16.0.0**

HYD-1 (config-router) # **network 172.17.0.0**

HYD-1 (config-router) # **network 17.0.0.0**

HYD-1 (config-router) # **end**

HYD-1 #

### BAN – Configuration

BAN # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

BAN (config) # **ip routing**

BAN (config) # **router rip**

BAN (config-router) # **version 2**

BAN (config-router) # **network 192.168.203.0**

BAN (config-router) # **network 172.17.0.0**

BAN (config-router) # **network 172.18.0.0**

BAN (config-router) # **network 18.0.0.0**

BAN (config-router) # **end**

BAN #



## Verify RIP Routing on IPv4 network

Once RIP routing is enabled, IPv4 Networks learnt via **RIP** are added into the routing table. “**R**” represents **RIP route**.

### CHE – Verification:

#### CHE # show ip route

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
 E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
 i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area  
 \* - candidate default, U - per-user static route, o - ODR  
 P - periodic downloaded static route

Gateway of last resort is not set

```
R 17.0.0.0/8 [120/1] via 172.16.0.2, 00:00:03, Serial0/0
    16.0.0.0/24 is subnetted, 3 subnets
C    16.1.1.0 is directly connected, Loopback1
C    16.1.3.0 is directly connected, Loopback3
C    16.1.2.0 is directly connected, Loopback2
R 18.0.0.0/8 [120/1] via 172.18.0.1, 00:00:24, Serial0/1
R 172.17.0.0/16 [120/1] via 172.16.0.2, 00:00:03, Serial0/0
    [120/1] via 172.18.0.1, 00:00:24, Serial0/1
C 172.16.0.0/16 is directly connected, Serial0/0
C 172.18.0.0/16 is directly connected, Serial0/1
C 192.168.201.0/24 is directly connected, FastEthernet0/0
R 192.168.202.0/24 [120/1] via 172.16.0.2, 00:00:03, Serial0/0
R 192.168.203.0/24 [120/1] via 172.18.0.1, 00:00:24, Serial0/1
CHE #
```

### HYD-1 – Verification:

#### HYD-1 # show ip route

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
 E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
 i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area  
 \* - candidate default, U - per-user static route, o - ODR  
 P - periodic downloaded static route

Gateway of last resort is not set

```
R 16.0.0.0/8 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
    17.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C    17.1.1.0/24 is directly connected, Loopback1
L    17.1.1.1/32 is directly connected, Loopback1
C    17.1.2.0/24 is directly connected, Loopback2
```



```

L    17.1.2.1/32 is directly connected, Loopback2
C    17.1.3.0/24 is directly connected, Loopback3
L    17.1.3.1/32 is directly connected, Loopback3
R    18.0.0.0/8 [120/1] via 172.17.0.2, 00:00:24, Serial0/0/0
    172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C    172.16.0.0/16 is directly connected, Serial0/0/1
L    172.16.0.2/32 is directly connected, Serial0/0/1
    172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C    172.17.0.0/16 is directly connected, Serial0/0/0
L    172.17.0.1/32 is directly connected, Serial0/0/0
R    172.18.0.0/16 [120/1] via 172.17.0.2, 00:00:24, Serial0/0/0
    [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
R    192.168.201.0/24 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
    192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.202.0/24 is directly connected, FastEthernet0/0
L    192.168.202.1/32 is directly connected, FastEthernet0/0
R    192.168.203.0/24 [120/1] via 172.17.0.2, 00:00:24, Serial0/0/0
HYD-1 #
  
```

#### **BAN – Verification:**

##### **BAN # show ip route**

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
 E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
 i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
 ia - IS-IS inter area, \* - candidate default, U - per-user static route  
 o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

```

R    17.0.0.0/8 [120/1] via 172.17.0.1, 00:00:07, Serial0/1
R    16.0.0.0/8 [120/1] via 172.18.0.2, 00:00:11, Serial0/0
    18.0.0.0/24 is subnetted, 3 subnets
C    18.1.3.0 is directly connected, Loopback3
C    18.1.2.0 is directly connected, Loopback2
C    18.1.1.0 is directly connected, Loopback1
C    172.17.0.0/16 is directly connected, Serial0/1
R    172.16.0.0/16 [120/1] via 172.17.0.1, 00:00:07, Serial0/1
    [120/1] via 172.18.0.2, 00:00:11, Serial0/0
C    172.18.0.0/16 is directly connected, Serial0/0
R    192.168.201.0/24 [120/1] via 172.18.0.2, 00:00:11, Serial0/0
R    192.168.202.0/24 [120/1] via 172.17.0.1, 00:00:07, Serial0/1
C    192.168.203.0/24 is directly connected, FastEthernet0/0
BAN #
  
```



## Verify communication between the IPv4 networks

### Verification from a Computer in HYD-1 Network

**ping 192.168.201.10**

```
PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.  
64 bytes from 192.168.201.10: icmp_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.201.10: icmp_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.201.10: icmp_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp_seq=4 ttl=62 time=24.0 ms
```

**ping 192.168.203.10**

```
PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms
```

**Repeat the above ping verification from a computer in CHE and BAN Network.**

### From a Computer in HYD-1 Network trace communication path to a Computer in CHE Network

```
tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)  
traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets  
 1  192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms  
 2  172.16.0.1 (172.16.0.1)  2.295 ms  2.156 ms  2.209 ms  
 3  192.168.201.10 (192.168.202.10)  3.295 ms  3.156 ms  3.209 ms
```

### From a Computer in HYD-1 Network trace communication path to a Computer in BAN Network

```
tracert 192.168.203.10 (Windows) or traceroute 192.168.203.10 (Linux)  
traceroute to 192.168.203.10 (192.168.203.10), 30 hops max, 38 byte packets  
 1  192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms  
 2  172.17.0.2 (172.17.0.2)  2.295 ms  2.156 ms  2.209 ms  
 3  192.168.203.10 (192.168.203.10)  3.295 ms  3.156 ms  3.209 ms
```

**Repeat the above trace communication path from a computer in CHE and BAN Network.**

## Verify RIP protocol default settings

### Example - HYD-1

HYD-1 # **show ip protocols**

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "rip"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Sending updates every 30 seconds, next due in 26 seconds

Invalid after 180 seconds, hold down 180, flushed after 240

Redistributing: rip

Default version control: send version 2, receive version 2

| Interface       | Send | Recv | Triggered RIP | Key-chain |
|-----------------|------|------|---------------|-----------|
| FastEthernet0/0 | 2    | 2    |               |           |
| Serial0/0/0     | 2    | 2    |               |           |
| Serial0/0/1     | 2    | 2    |               |           |
| Loopback1       | 2    | 2    |               |           |
| Loopback2       | 2    | 2    |               |           |
| Loopback3       | 2    | 2    |               |           |

Automatic network summarization is in effect

Maximum path: 4

Routing for Networks:

17.0.0.0

172.16.0.0

172.17.0.0

192.168.202.0

Routing Information Sources:

| Gateway    | Distance | Last Update |
|------------|----------|-------------|
| 172.16.0.1 | 120      | 00:00:01    |
| 172.17.0.2 | 120      | 00:00:23    |

Distance: (default is 120)

HYD-1 #

## Verify RIP Update Packets

Verify default behaviour of RIP Update packets by enabling debug commands

### Example - HYD-1

HYD-1 # **terminal monitor**

HYD-1 # **debug ip rip**

RIP protocol debugging is on

RIP: received v2 update from 172.16.0.1 on Serial0/0/1

172.18.0.0/16 in 1 hops

192.168.201.0/24 in 1 hops

192.168.203.0/24 in 2 hops

RIP: sending v2 update to 224.0.0.9 via FastEthernet0/0 (192.168.202.1)



```

RIP: build update entries
network 172.16.0.0/16 metric 1
network 172.17.0.0/16 metric 1
network 172.18.0.0/16 metric 2
network 192.168.201.0/24 metric 2
network 192.168.203.0/24 metric 2
RIP: sending v2 update to 224.0.0.9 via Serial0/0/1 (172.16.0.2)
RIP: build update entries
network 192.168.202.0/24 metric 1
network 172.17.0.0/16 metric 1
network 192.168.203.0/24 metric 2
RIP: sending v2 update to 224.0.0.9 via Serial0/0/0 (172.17.0.1)
RIP: build update entries
network 192.168.202.0/24 metric 1
network 172.16.0.0/16 metric 1
network 192.168.201.0/24 metric 2

```

```

HYD-1 # undebug all
HYD-1 # terminal no monitor

```

### Changing RIP Timers

Changing default RIP timers i.e. Update, Invalid, Hold and Flush Timers.

#### Example - HYD-1

```

HYD-1 (config) # router rip
HYD-1 (config-router) # timers basic 15 90 90 120
HYD-1 (config-router) # exit
HYD-1 (config) # exit

```

#### HYD-1 – Verification :

```

HYD-1 # show ip protocols
*** IP Routing is NSF aware ***

```

```

Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 15 seconds, next due in 13 seconds
  Invalid after 90 seconds, hold down 90, flushed after 120
  Redistributing: rip
  Default version control: send version 2, receive version 2
  Interface      Send Recv Triggered RIP Key-chain
FastEthernet0/0  2    2
Serial0/0/0      2    2
Serial0/0/1      2    2
Loopback1        2    2
Loopback2        2    2
Loopback3        2    2

```

Automatic network summarization is in effect

Maximum path: 4

Routing for Networks:

```
17.0.0.0
172.16.0.0
172.17.0.0
192.168.202.0
```

Routing Information Sources:

| Gateway    | Distance | Last Update |
|------------|----------|-------------|
| 172.16.0.1 | 120      | 00:00:01    |
| 172.17.0.2 | 120      | 00:00:23    |

Distance: (default is 120)

HYD-1 #

### Enabling Passive Interface on RIP

To disable sending of RIP updates packet on selected Interface. (i.e. FastEthernet Interface) we use the passive interface command.

#### Example – HYD-1

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **router rip**

HYD-1 (config-router) # **passive-interface fastethernet 0/0**

HYD-1 (config-router) # **end**

After enabling passive interface, again verify the behaviour of RIP Update packets by enabling debug commands. Now you will not see the following line in the debug outputs.

**RIP: sending v2 update to 224.0.0.9 via fastethernet 0/0**

This means you have successfully disabled sending of RIP updates packet on selected Interface.

#### HYD-1 – Verification:

HYD-1 # **show ip protocols**

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "rip"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Sending updates every 30 seconds, next due in 26 seconds

Invalid after 180 seconds, hold down 180, flushed after 240

Redistributing: rip

Default version control: send version 2, receive version 2

| Interface       | Send | Recv | Triggered | RIP | Key-chain |
|-----------------|------|------|-----------|-----|-----------|
| FastEthernet0/0 | 2    | 2    |           |     |           |
| Serial0/0/0     | 2    | 2    |           |     |           |



```
Serial0/0/1    2  2
Loopback1     2  2
Loopback2     2  2
Loopback3     2  2
```

Automatic network summarization is in effect

Maximum path: 4

Routing for Networks:

```
172.16.0.0
172.17.0.0
192.168.202.0
```

Passive Interface(s):

```
FastEthernet0/0
```

Routing Information Sources:

| Gateway    | Distance | Last Update |
|------------|----------|-------------|
| 172.16.0.1 | 120      | 00:00:01    |
| 172.17.0.2 | 120      | 00:00:23    |

Distance: (default is 120)

HYD-1 #

### Verify RIP Database

HYD-1 # **show ip rip database**

```
16.0.0.0/8  auto-summary
16.0.0.0/8
  [1] via 172.16.0.1, 00:00:01, Serial0/0/1
17.0.0.0/8  auto-summary
17.1.1.0/24  directly connected, Loopback1
17.1.2.0/24  directly connected, Loopback2
17.1.3.0/24  directly connected, Loopback3
18.0.0.0/8  auto-summary
18.0.0.0/8
  [1] via 172.17.0.2, 00:00:23, Serial0/0/0
172.16.0.0/16 auto-summary
172.16.0.0/16 directly connected, Serial0/0/1
172.17.0.0/16 auto-summary
172.17.0.0/16 directly connected, Serial0/0/0
172.18.0.0/16 auto-summary
172.18.0.0/16
  [1] via 172.17.0.2, 00:00:23, Serial0/0/0
  [1] via 172.16.0.1, 00:00:01, Serial0/0/1
192.168.201.0/24 auto-summary
192.168.201.0/24
  [1] via 172.16.0.1, 00:00:01, Serial0/0/1
192.168.202.0/24 auto-summary
192.168.202.0/24 directly connected, FastEthernet0/0
192.168.203.0/24 auto-summary
192.168.203.0/24
  [1] via 172.17.0.2, 00:00:23, Serial0/0/0
```



## Disabling RIP Auto Summary

By default RIP auto summary is enabled on CISCO IOS prior to 12.4. Let's try to understand the difference in routing table output when auto summary is enabled and when it is disabled.

### Verify Routing Table on HYD-1

HYD-1 # **show ip route**

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area

\* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is not set

```
R 16.0.0.0/8 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
  17.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C   17.1.1.0/24 is directly connected, Loopback1
L   17.1.1.1/32 is directly connected, Loopback1
C   17.1.2.0/24 is directly connected, Loopback2
L   17.1.2.1/32 is directly connected, Loopback2
C   17.1.3.0/24 is directly connected, Loopback3
L   17.1.3.1/32 is directly connected, Loopback3
R 18.0.0.0/8 [120/1] via 172.17.0.2, 00:00:24, Serial0/0/0
  172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C   172.16.0.0/16 is directly connected, Serial0/0/1
L   172.16.0.2/32 is directly connected, Serial0/0/1
  172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C   172.17.0.0/16 is directly connected, Serial0/0/0
L   172.17.0.1/32 is directly connected, Serial0/0/0
R 172.18.0.0/16 [120/1] via 172.17.0.2, 00:00:24, Serial0/0/0
  [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
R 192.168.201.0/24 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
  192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C   192.168.202.0/24 is directly connected, FastEthernet0/0
L   192.168.202.1/32 is directly connected, FastEthernet0/0
R 192.168.203.0/24 [120/1] via 172.17.0.2, 00:00:24, Serial0/0/0
HYD-1 #
```

### Disable Auto Summary on CHE

CHE # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

CHE (config) # **router rip**

CHE (config-router)# **no auto-summary**

CHE (config-router)# **end**



## Verify Routing Table on HYD-1

HYD-1 # **show ip route**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
 E1 - OSPF external type 1, E2 - OSPF external type 2  
 i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
 ia - IS-IS inter area, \* - candidate default, U - per-user static route  
 o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP  
 + - replicated route, % - next hop override

Gateway of last resort is not set

```

16.0.0.0/24 is subnetted, 3 subnets
R   16.1.1.0 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
R   16.1.2.0 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
R   16.1.3.0 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
17.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C   17.1.1.0/24 is directly connected, Loopback1
L   17.1.1.1/32 is directly connected, Loopback1
C   17.1.2.0/24 is directly connected, Loopback2
L   17.1.2.1/32 is directly connected, Loopback2
C   17.1.3.0/24 is directly connected, Loopback3
L   17.1.3.1/32 is directly connected, Loopback3
R   18.0.0.0/8 [120/1] via 172.17.0.2, 00:00:24, Serial0/0/0
172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C   172.16.0.0/16 is directly connected, Serial0/0/1
L   172.16.0.2/32 is directly connected, Serial0/0/1
172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C   172.17.0.0/16 is directly connected, Serial0/0/0
L   172.17.0.1/32 is directly connected, Serial0/0/0
R   172.18.0.0/16 [120/1] via 172.17.0.2, 00:00:13, Serial0/0/0
    [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
R   192.168.201.0/24 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C   192.168.202.0/24 is directly connected, FastEthernet0/0
L   192.168.202.1/32 is directly connected, FastEthernet0/0
R   192.168.203.0/24 [120/1] via 172.17.0.2, 00:00:13, Serial0/0/0
  
```

HYD-1 #

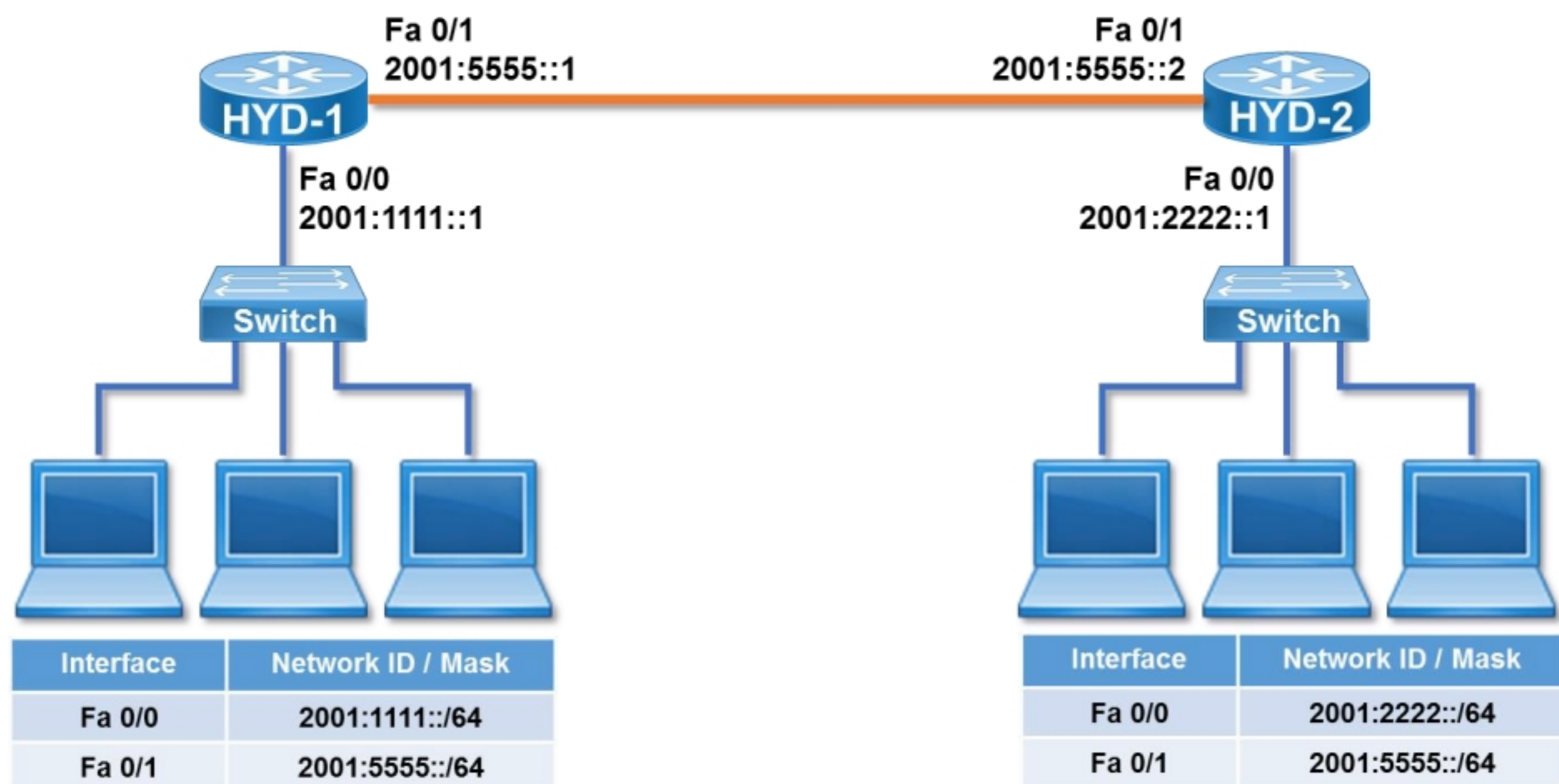
## LAB 11: RIPng ON IPv6 NETWORK

### OBJECTIVE:

To configure RIPng routing for communicating between different IPv6 networks on different routers.

### TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



**Pre-requisite:** WAN Interface configuration to be done on the router (LAB – 7)

### TASK:

- Configure RIPng on IPv6 Network
- Verify RIPng on IPv6 Network
- Verify Communication between the IPv6 networks
- Verify RIPng protocol default settings



## Configure RIPng on IPv6 Network

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ipv6 unicast-routing**

HYD-1 (config) # **ipv6 router rip cisco**

HYD-1 (config-rtr) # **exit**

HYD-1 (config) # **interface fastethernet 0/0**

HYD-1 (config-if) # **ipv6 rip cisco enable**

HYD-1 (config-if) # **exit**

HYD-1 (config) # **interface fastethernet 0/1**

HYD-1 (config-if) # **ipv6 rip cisco enable**

HYD-1 (config-if) # **end**

HYD-1 #

### HYD-2 – Configuration

HYD-2 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-2 (config) # **ipv6 unicast-routing**

HYD-2 (config) # **ipv6 router rip cisco**

HYD-2 (config-rtr) # **exit**

HYD-2 (config) # **interface fastethernet 0/0**

HYD-2 (config-if) # **ipv6 rip cisco enable**

HYD-2 (config-if) # **exit**

HYD-2 (config) # **interface fastethernet 0/1**

HYD-2 (config-if) # **ipv6 rip cisco enable**

HYD-2 (config-if) # **end**

HYD-2 #

## Verify RIPng on IPv6 Network

Once RIP routing is enabled, IPv6 Networks learnt via **RIP** are added into the routing table. “**R**” represents **RIP route**.

### HYD-1 – Verification:

HYD-1 # **show ipv6 route**

IPv6 Routing Table - default - 6 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP

I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2

```
C 2001:1111::/64 [0/0]
  via FastEthernet0/0, directly connected
L 2001:1111::1/128 [0/0]
  via FastEthernet0/0, receive
R 2001:2222::/64 [120/2]
  via FE80::21C:F6FF:FE85:1FA1, FastEthernet0/1
C 2001:5555::/64 [0/0]
  via FastEthernet0/1, directly connected
L 2001:5555::1/128 [0/0]
  via FastEthernet0/1, receive
L FF00::/8 [0/0]
  via Null0, receive
HYD-1 #
```

### HYD-2 – Verification:

HYD-2 # **show ipv6 route**

IPv6 Routing Table - default - 6 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP

I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2

```
R 2001:1111::/64 [120/2]
  via FE80::21C:F6FF:FE85:1FA1, FastEthernet0/1
C 2001:2222::/64 [0/0]
  via FastEthernet0/0, directly connected
L 2001:2222::1/128 [0/0]
  via FastEthernet0/0, receive
C 2001:5555::/64 [0/0]
  via FastEthernet0/1, directly connected
L 2001:5555::2/128 [0/0]
  via FastEthernet0/1, receive
L FF00::/8 [0/0]
  via Null0, receive
HYD-2#
```



## Verify communication between the IPv6 networks

### Verification from a Computer in HYD-1 Network

**ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)**

```
PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=62 time=0.336 ms
```

### Verification from a Computer in HYD-2 Network

**ping 2001:1111::10 (Windows) or ping6 2001:1111::10 (Linux)**

```
PING 2001:1111::10(2001:1111::10) 56 data bytes
64 bytes from 2001:1111::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:1111::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:1111::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:1111::10: icmp_seq=4 ttl=62 time=0.336 ms
```

### From a Computer in HYD-1 Network trace communication path to a Computer in HYD-2 Network

**tracert 2001:2222::10 (Windows) or traceroute6 2001:2222::10 (Linux)**

```
traceroute to 2001:2222::10 (2001:2222::10), 30 hops max, 80 byte packets
 1  2001:1111::1 (2001:1111::1)  2.825 ms  3.239 ms  3.665 ms
 2  2001:5555::2 (2001:5555::2)  9.086 ms  9.393 ms  9.642 ms
 3  2001:2222::10 (2001:2222::10)  9.781 ms  10.474 ms  10.720 ms
```

### From a Computer in HYD-2 Network trace communication path to a Computer in HYD-1 Network

**tracert 2001:1111::10 (Windows) or traceroute6 2001:1111::10 (Linux)**

```
traceroute to 2001:1111::10 (2001:1111::10), 30 hops max, 80 byte packets
 1  2001:2222::1 (2001:2222::1)  1.071 ms  1.152 ms  1.238 ms
 2  2001:5555::1 (2001:5555::1)  4.303 ms  4.930 ms  5.419 ms
 3  2001:1111::10 (2001:1111::10)  10.832 ms  11.444 ms  11.541 ms
```

## LAB 12: OSPF ON IPv4 NETWORK

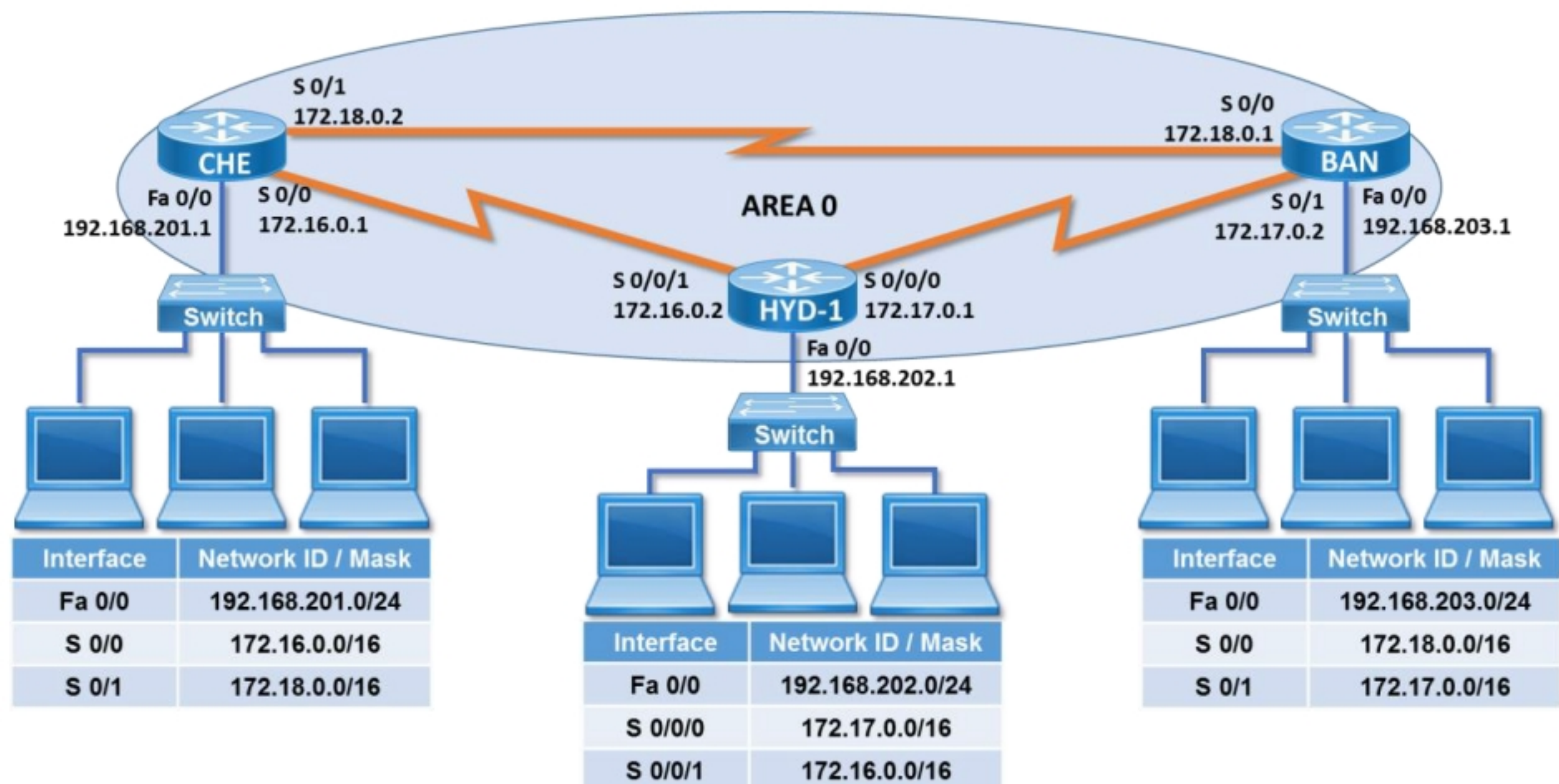
### OBJECTIVE:

To configure OSPF Routing in a single area.

To understand how OSPF works and fine tune OSPF configuration.

### TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below:



**Pre-requisite: WAN Interface configuration to be done on the router (LAB – 6)**

### TASK:

- Configure OSPF – Single Area on IPv4 network
- Verify OSPF – Single Area on IPv4 network
- Verify Communication between the IPv4 networks
- Verify OSPF Neighbour and Topology Table
- Verify OSPF protocol default settings
- Verify OSPF Packets on IPv4 network
- Enable Passive Interface on IPv4 network
- Configuring OSPF Cost metric for an interface



## Configure OSPF – Single Area on IPv4 Network

### CHE – Configuration

CHE # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

CHE (config) # **ip routing**

CHE (config) # **router ospf 1**

CHE (config-router) # **router-id 1.1.1.1**

CHE (config-router) # **network 192.168.201.0 0.0.0.255 area 0**

CHE (config-router) # **network 172.16.0.0 0.0.255.255 area 0**

CHE (config-router) # **network 172.18.0.0 0.0.255.255 area 0**

CHE (config-router) # **end**

CHE #

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ip routing**

HYD-1 (config) # **router ospf 2**

HYD-1 (config-router) # **router-id 2.2.2.2**

HYD-1 (config-router) # **network 192.168.202.0 0.255.255.255 area 0**

HYD-1 (config-router) # **network 172.16.0.0 0.0.255.255 area 0**

HYD-1 (config-router) # **network 172.17.0.0 0.0.255.255 area 0**

HYD-1 (config-router) # **end**

HYD-1 #

### BAN – Configuration

BAN # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

BAN (config) # **ip routing**

BAN (config) # **router ospf 3**

BAN (config-router) # **router-id 3.3.3.3**

BAN (config-router) # **network 192.168.203.0 0.0.0.255 area 0**

BAN (config-router) # **network 172.17.0.0 0.0.255.255 area 0**

BAN (config-router) # **network 172.18.0.0 0.0.255.255 area 0**

BAN (config-router) # **end**

BAN #

## Verify OSPF – Single Area on IPv4 Network

Once OSPF routing is enabled, the IPv4 Networks learned through **OSPF** are added into the routing table. “O” represents an **OSPF route**.

### CHE – Verification:

CHE # **show ip route**

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
 E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
 i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area  
 \* - candidate default, U - per-user static route, o - ODR  
 P - periodic downloaded static route

Gateway of last resort is not set

```
O 172.17.0.0/16 [110/128] via 172.16.0.2, 00:00:26, Serial0/0
    [110/128] via 172.18.0.1, 00:00:26, Serial0/1
C 172.16.0.0/16 is directly connected, Serial0/0
C 172.18.0.0/16 is directly connected, Serial0/1
C 192.168.201.0/24 is directly connected, FastEthernet0/0
O 192.168.202.0/24 [110/64] via 172.16.0.2, 00:00:26, Serial0/0
O 192.168.203.0/24 [110/64] via 172.18.0.1, 00:00:26, Serial0/1
CHE #
```

### HYD-1 – Verification:

HYD-1 # **show ip route**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
 E1 - OSPF external type 1, E2 - OSPF external type 2  
 i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
 ia - IS-IS inter area, \* - candidate default, U - per-user static route  
 o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP  
 + - replicated route, % - next hop override

Gateway of last resort is not set

```
172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.16.0.0/16 is directly connected, Serial0/0/1
L 172.16.0.2/32 is directly connected, Serial0/0/1
172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.17.0.0/16 is directly connected, Serial0/0/0
L 172.17.0.1/32 is directly connected, Serial0/0/0
```



```
O 172.18.0.0/16 [110/128] via 172.17.0.2, 00:01:21, Serial0/0/0
    [110/128] via 172.16.0.1, 00:03:17, Serial0/0/1
O 192.168.201.0/24 [110/64] via 172.16.0.1, 00:03:17, Serial0/0/1
    192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.202.0/24 is directly connected, FastEthernet0/0
L 192.168.202.1/32 is directly connected, FastEthernet0/0
O 192.168.203.0/24 [110/64] via 172.17.0.2, 00:01:21, Serial0/0/0
HYD-1 #
```

### **BAN – Verification:**

#### **BAN # show ip route**

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, \* - candidate default, U - per-user static route  
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

```
C 172.17.0.0/16 is directly connected, Serial0/1
O 172.16.0.0/16 [110/128] via 172.17.0.1, 00:01:40, Serial0/1
    [110/128] via 172.18.0.2, 00:01:40, Serial0/0
C 172.18.0.0/16 is directly connected, Serial0/0
O 192.168.201.0/24 [110/64] via 172.18.0.2, 00:01:40, Serial0/0
O 192.168.202.0/24 [110/64] via 172.17.0.1, 00:01:40, Serial0/1
C 192.168.203.0/24 is directly connected, FastEthernet0/0
BAN #
```

### **Verify communication between the IPv4 networks**

#### **Verification from a Computer in HYD-1 Network**

##### **ping 192.168.201.10**

```
PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=4 ttl=62 time=24.0 ms
```

**ping 192.168.203.10**

```
PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data:
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms
```

**Repeat the above ping verification from a computer in CHE and BAN Network.**

**From a Computer in HYD-1 Network trace communication path to a Computer in CHE Network**

```
tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)
traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets
 1  192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2  172.16.0.1 (172.16.0.1)  2.295 ms  2.156 ms  2.209 ms
 3  192.168.201.10 (192.168.202.10)  3.295 ms  3.156 ms  3.209 ms
```

**From a Computer in HYD-1 Network trace communication path to a Computer in BAN Network**

```
tracert 192.168.203.10 (Windows) or traceroute 192.168.203.10 (Linux)
traceroute to 192.168.203.10 (192.168.203.10), 30 hops max, 38 byte packets
 1  192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2  172.17.0.2 (172.17.0.2)  2.295 ms  2.156 ms  2.209 ms
 3  192.168.203.10 (192.168.203.10)  3.295 ms  3.156 ms  3.209 ms
```

**Repeat the above trace communication path from a computer in CHE and BAN Network.**

**Verify OSPF Neighbour and Database Table**

**CHE – Verification:**

**CHE # show ip ospf neighbor**

| Neighbor ID | Pri | State   | Dead Time | Address    | Interface |
|-------------|-----|---------|-----------|------------|-----------|
| 2.2.2.2     | 1   | FULL/ - | 00:00:33  | 172.16.0.2 | Serial0/0 |
| 3.3.3.3     | 1   | FULL/ - | 00:00:37  | 172.18.0.1 | Serial0/1 |

CHE #

**CHE # show ip ospf database**

OSPF Router with ID (1.1.1.1) (Process ID 1)

Router Link States (Area 0)

| Link ID | ADV Router | Age | Seq#       | Checksum | Link count |
|---------|------------|-----|------------|----------|------------|
| 1.1.1.1 | 1.1.1.1    | 56  | 0x80000005 | 0x385F   | 5          |
| 2.2.2.2 | 2.2.2.2    | 48  | 0x80000005 | 0xD3A9   | 5          |
| 3.3.3.3 | 3.3.3.3    | 46  | 0x80000004 | 0x87B    | 5          |

CHE #



### HYD-1 – Verification:

HYD-1 # show ip ospf neighbor

| Neighbor ID | Pri | State   | Dead Time | Address    | Interface   |
|-------------|-----|---------|-----------|------------|-------------|
| 3.3.3.3     | 0   | FULL/ - | 00:00:32  | 172.17.0.2 | Serial0/0/0 |
| 1.1.1.1     | 0   | FULL/ - | 00:00:31  | 172.16.0.1 | Serial0/0/1 |

HYD-1 #

HYD-1 # show ip ospf database

OSPF Router with ID (2.2.2.2) (Process ID 2)

Router Link States (Area 0)

| Link ID | ADV Router | Age | Seq#       | Checksum | Link count |
|---------|------------|-----|------------|----------|------------|
| 1.1.1.1 | 1.1.1.1    | 56  | 0x80000005 | 0x385F   | 5          |
| 2.2.2.2 | 2.2.2.2    | 48  | 0x80000005 | 0xD3A9   | 5          |
| 3.3.3.3 | 3.3.3.3    | 46  | 0x80000004 | 0x87B    | 5          |

HYD-1 #

### BAN – Verification:

BAN # show ip ospf neighbor

| Neighbor ID | Pri | State   | Dead Time | Address    | Interface |
|-------------|-----|---------|-----------|------------|-----------|
| 1.1.1.1     | 1   | FULL/ - | 00:00:39  | 172.18.0.2 | Serial0/0 |
| 2.2.2.2     | 1   | FULL/ - | 00:00:33  | 172.17.0.1 | Serial0/1 |

BAN #

BAN # show ip ospf database

OSPF Router with ID (3.3.3.3) (Process ID 3)

Router Link States (Area 0)

| Link ID | ADV Router | Age | Seq#       | Checksum | Link count |
|---------|------------|-----|------------|----------|------------|
| 1.1.1.1 | 1.1.1.1    | 56  | 0x80000005 | 0x385F   | 5          |
| 2.2.2.2 | 2.2.2.2    | 48  | 0x80000005 | 0xD3A9   | 5          |
| 3.3.3.3 | 3.3.3.3    | 46  | 0x80000004 | 0x87B    | 5          |

BAN #

## Verify OSPF protocol default settings

### Example - HYD-1

```
HYD-1 # show ip protocols
*** IP Routing is NSF aware ***
Routing Protocol is "ospf 2"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 2.2.2.2
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    172.16.0.0 0.0.255.255 area 0
    172.17.0.0 0.0.255.255 area 0
    192.168.202.0 0.0.0.255 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    3.3.3.3          110          00:01:20
    1.1.1.1          110          00:03:16
  Distance: (default is 110)
HYD-1#
```

## Verify OSPF Hello Packets

Verify default behaviour of OSPF Hello packets by enabling debug commands

### Example - HYD-1

```
HYD-1 # terminal monitor
HYD-1 # debug ip ospf hello
OSPF hello events debugging is on
HYD-1#
*Jul 22 20:00:44.967: OSPF: Rcv hello from 192.168.203.1 area 0 from Serial0/0/0 172.17.0.2
*Jul 22 20:00:44.967: OSPF: End of hello processing
*Jul 22 20:00:46.011: OSPF: Send hello to 224.0.0.5 area 0 on GigabitEthernet0/0 from 10.0.0.1
*Jul 22 20:00:47.959: OSPF: Rcv hello from 192.168.201.1 area 0 from Serial0/0/1 172.16.0.1
*Jul 22 20:00:47.959: OSPF: End of hello processing
*Jul 22 20:00:49.779: OSPF: Send hello to 224.0.0.5 area 0 on Serial0/0/0 from 172.17.0.1
*Jul 22 20:00:51.263: OSPF: Send hello to 224.0.0.5 area 0 on Serial0/0/1 from 172.16.0.2
*Jul 22 20:00:54.967: OSPF: Rcv hello from 192.168.203.1 area 0 from Serial0/0/0 172.17.0.2
*Jul 22 20:00:54.967: OSPF: End of hello processing
*Jul 22 20:00:55.279: OSPF: Send hello to 224.0.0.5 area 0 on GigabitEthernet0/0 from 10.0.0.1
*Jul 22 20:00:57.959: OSPF: Rcv hello from 192.168.201.1 area 0 from Serial0/0/1 172.16.0.1
*Jul 22 20:00:57.959: OSPF: End of hello processing
*Jul 22 20:00:59.011: OSPF: Send hello to 224.0.0.5 area 0 on Serial0/0/0 from 172.17.0.1
*Jul 22 20:01:00.963: OSPF: Send hello to 224.0.0.5 area 0 on Serial0/0/1 from 172.16.0.2
HYD-1 #

HYD-1 # undebug all
HYD-1 # terminal no monitor
```



### Enable passive interface on OSPF

This command disables OSPF Hello packets from being sent on that interface.

#### Example - HYD-1

HYD-1# **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **router ospf 2**

HYD-1 (config-router) # **passive-interface FastEthernet 0/0**

HYD-1 (config-router) # **end**

After enabling above commands, again verify default behaviour of OSPF Hello packets by enabling debug commands. Now you will not be able to see the following line in the debug outputs.

**OSPF: Send hello to 224.0.0.5 area 0 on FastEthernet 0/0 from 192.168.202.1**

This means that you have successfully disabled sending of OSPF Hello packet on selected Interface.

#### HYD-1 – Verification:

HYD-1 # **show ip protocols**

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "ospf 2"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Router ID 2.2.2.2

Number of areas in this router is 1. 1 normal 0 stub 0 nssa

Maximum path: 4

Routing for Networks:

172.16.0.0 0.0.255.255 area 0

172.17.0.0 0.0.255.255 area 0

192.168.202.0 0.0.0.255 area 0

Passive Interface(s):

FastEthernet0/0

Routing Information Sources:

| Gateway | Distance | Last Update |
|---------|----------|-------------|
|---------|----------|-------------|

|         |     |          |
|---------|-----|----------|
| 3.3.3.3 | 110 | 00:01:20 |
|---------|-----|----------|

|         |     |          |
|---------|-----|----------|
| 1.1.1.1 | 110 | 00:03:16 |
|---------|-----|----------|

Distance: (default is 110)

### Configuring OSPF Cost metric for an interface

This command will configure OSPF Cost metric for an interface.

#### Verification - HYD-1

HYD-1 # **show ip ospf interface brief**

| Interface | PID | Area | IP Address/Mask | Cost | State | Nbrs | F/C |
|-----------|-----|------|-----------------|------|-------|------|-----|
| Se0/0/0   | 1   | 0    | 172.17.0.1/16   | 64   | P2P   | 1/1  |     |
| Se0/0/1   | 1   | 0    | 172.16.0.2/16   | 64   | P2P   | 1/1  |     |

HYD-1 #

#### Example - HYD-1

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **interface serial 0/0/0**

HYD-1 (config-router) # **ip ospf cost 100**

HYD-1 (config-router) # **end**

HYD-1 #

#### Verification - HYD-1

HYD-1 # **show ip ospf interface brief**

| Interface | PID | Area | IP Address/Mask | Cost | State | Nbrs | F/C |
|-----------|-----|------|-----------------|------|-------|------|-----|
| Se0/0/0   | 1   | 0    | 172.17.0.1/16   | 100  | P2P   | 1/1  |     |
| Se0/0/1   | 1   | 0    | 172.16.0.2/16   | 64   | P2P   | 1/1  |     |

HYD-1 #



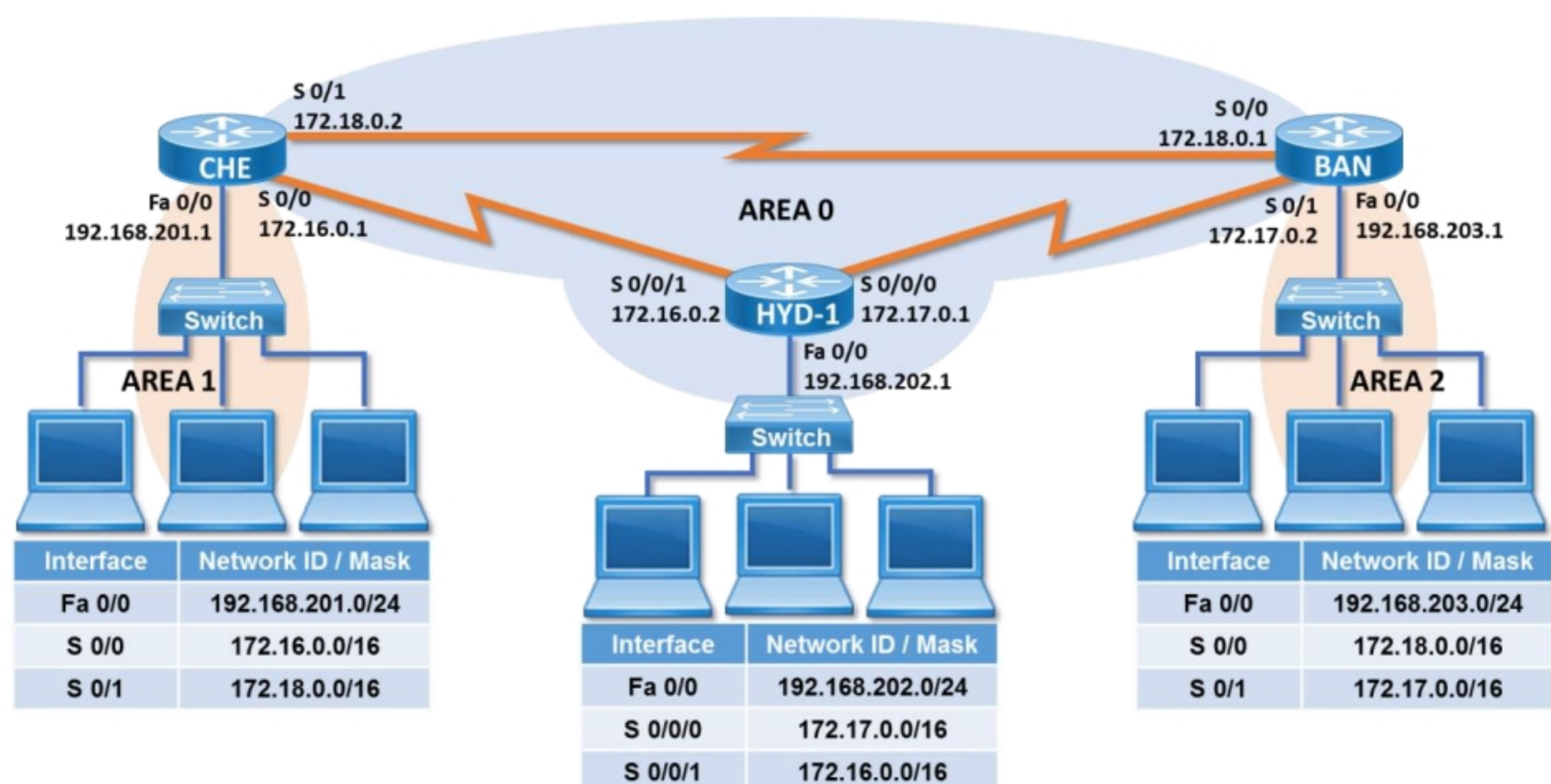
## LAB 13: OSPF – MULTIPLE AREA ON IPv4 NETWORK

### OBJECTIVE:

To configure OSPF with a backbone area (area 0) and multiple areas connected to the backbone.

### TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below:



Pre-requisite: WAN Interface configuration to be done on the router (LAB – 6)

### TASK:

- Configure OSPF – Multiple Area on IPv4 network
- Verify OSPF – Multiple Area on IPv4 network
- Verify Communication between the IPv4 networks
- Verify OSPF Neighbour and Topology Table

## **Configure OSPF Routing with backbone area and multiple connected areas on IPv4 Network**

### **CHE – Configuration**

**CHE # configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

**CHE (config) # ip routing**

**CHE (config) # router ospf 1**

**CHE (config-router) # router-id 1.1.1.1**

**CHE (config-router) # network 192.168.201.0 0.0.0.255 area 1**

**CHE (config-router) # network 172.16.0.0 0.0.255.255 area 0**

**CHE (config-router) # network 172.18.0.0 0.0.255.255 area 0**

**CHE (config-router) # end**

**CHE #**

### **HYD-1 – Configuration**

**HYD-1 # configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

**HYD-1 (config) # ip routing**

**HYD-1 (config) # router ospf 2**

**HYD-1 (config-router) # router-id 2.2.2.2**

**HYD-1 (config-router) # network 192.168.202.0 0.255.255.255 area 0**

**HYD-1 (config-router) # network 172.16.0.0 0.0.255.255 area 0**

**HYD-1 (config-router) # network 172.17.0.0 0.0.255.255 area 0**

**HYD-1 (config-router) # end**

**HYD-1 #**

### **BAN – Configuration**

**BAN # configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

**BAN (config) # ip routing**

**BAN (config) # router ospf 3**

**BAN (config-router) # router-id 3.3.3.3**

**BAN (config-router) # network 192.168.203.0 0.0.0.255 area 2**

**BAN (config-router) # network 172.17.0.0 0.0.255.255 area 0**

**BAN (config-router) # network 172.18.0.0 0.0.255.255 area 0**

**BAN (config-router) # end**

**BAN #**



## Verify OSPF – Multiple Area on IPv4 Network

Once OSPF routing is enabled, IP networks learned through **OSPF** are added into the routing table.

“**IA**” represents **OSPF Inter Area route**.

### CHE – Verification:

CHE # **show ip route**

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

```
O 172.17.0.0/16 [110/128] via 172.18.0.1, 00:00:50, Serial0/1
    [110/128] via 172.16.0.2, 00:00:50, Serial0/0
C 172.16.0.0/16 is directly connected, Serial0/0
C 172.18.0.0/16 is directly connected, Serial0/1
C 192.168.201.0/24 is directly connected, FastEthernet0/0
O 192.168.202.0/24 [110/64] via 172.16.0.2, 00:00:50, Serial0/0
O IA 192.168.203.0/24 [110/64] via 172.18.0.1, 00:00:49, Serial0/1
CHE #
```

### HYD-1 – Verification:

HYD-1 # **show ip route**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

o - ODR, P - periodic downloaded static route, + - replicated route

Gateway of last resort is not set

```
172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.16.0.0/16 is directly connected, Serial0/0/1
L 172.16.0.2/32 is directly connected, Serial0/0/1
172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.17.0.0/16 is directly connected, Serial0/0/0
L 172.17.0.1/32 is directly connected, Serial0/0/0
O 172.18.0.0/16 [110/128] via 172.17.0.2, 00:02:23, Serial0/0/0
    [110/128] via 172.16.0.1, 00:02:23, Serial0/0/1
```

```
O IA 192.168.201.0/24 [110/64] via 172.16.0.1, 00:02:23, Serial0/0/1
    192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.202.0/24 is directly connected, FastEthernet0/0
L    192.168.202.1/32 is directly connected, FastEthernet0/0
O IA 192.168.203.0/24 [110/64] via 172.17.0.2, 00:01:25, Serial0/0/0
HYD-1 #
```

### **BAN – Verification:**

BAN # **show ip route**

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS  
ia - IS-IS inter area, \* - candidate default, U - per-user sta  
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

```
C 172.17.0.0/16 is directly connected, Serial0/1
O 172.16.0.0/16 [110/128] via 172.18.0.2, 00:02:02, Serial0/0
    [110/128] via 172.17.0.1, 00:02:02, Serial0/1
C 172.18.0.0/16 is directly connected, Serial0/0
O IA 192.168.201.0/24 [110/64] via 172.18.0.2, 00:02:02, Serial0/0
O 192.168.202.0/24 [110/64] via 172.17.0.1, 00:02:02, Serial0/1
C 192.168.203.0/24 is directly connected, FastEthernet0/0
BAN #
```

### **Verify communication between the IPv4 networks**

#### **Verification from a Computer in HYD-1 Network**

**ping 192.168.201.10**

```
PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=4 ttl=62 time=24.0 ms
```



**ping 192.168.203.10**

```
PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms
```

**Repeat the above ping verification from a computer in CHE and BAN Network.**

**From a Computer in HYD-1 Network trace communication path to a Computer in CHE Network**

```
tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)  
traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets  
 1  192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms  
 2  172.16.0.1 (172.16.0.1)  2.295 ms  2.156 ms  2.209 ms  
 3  192.168.201.10 (192.168.202.10)  3.295 ms  3.156 ms  3.209 ms
```

**From a Computer in HYD-1 Network trace communication path to a Computer in BAN Network**

```
tracert 192.168.203.10 (Windows) or traceroute 192.168.203.10 (Linux)  
traceroute to 192.168.203.10 (192.168.203.10), 30 hops max, 38 byte packets  
 1  192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms  
 2  172.17.0.2 (172.17.0.2)  2.295 ms  2.156 ms  2.209 ms  
 3  192.168.203.10 (192.168.203.10)  3.295 ms  3.156 ms  3.209 ms
```

**Repeat the above trace communication path from a computer in CHE and BAN Network.**

## Verify OSPF Neighbour and Database Table

### CHE – Verification:

CHE # show ip ospf neighbor

| Neighbor ID | Pri | State   | Dead Time | Address    | Interface |
|-------------|-----|---------|-----------|------------|-----------|
| 2.2.2.2     | 1   | FULL/ - | 00:00:33  | 172.16.0.2 | Serial0/0 |
| 3.3.3.3     | 1   | FULL/ - | 00:00:37  | 172.18.0.1 | Serial0/1 |

CHE #

CHE # show ip ospf database

OSPF Router with ID (1.1.1.1) (Process ID 1)

Router Link States (Area 0)

| Link ID | ADV Router | Age | Seq#       | Checksum | Link count |
|---------|------------|-----|------------|----------|------------|
| 1.1.1.1 | 1.1.1.1    | 56  | 0x80000005 | 0x385F   | 4          |
| 2.2.2.2 | 2.2.2.2    | 48  | 0x80000005 | 0xD3A9   | 5          |
| 3.3.3.3 | 3.3.3.3    | 46  | 0x80000004 | 0x87B    | 4          |

Summary Net Link States (Area 0)

| Link ID       | ADV Router | Age | Seq#       | Checksum |
|---------------|------------|-----|------------|----------|
| 192.168.201.0 | 1.1.1.1    | 586 | 0x80000001 | 0x655    |
| 192.168.203.0 | 1.1.1.1    | 586 | 0x80000001 | 0x655    |

Router Link States (Area 1)

| Link ID | ADV Router | Age | Seq#       | Checksum | Link count |
|---------|------------|-----|------------|----------|------------|
| 1.1.1.1 | 1.1.1.1    | 596 | 0x80000001 | 0x4B98   | 1          |

Summary Net Link States (Area 1)

| Link ID       | ADV Router | Age | Seq#       | Checksum |
|---------------|------------|-----|------------|----------|
| 192.168.202.0 | 1.1.1.1    | 379 | 0x80000001 | 0x7312   |
| 172.16.0.0    | 1.1.1.1    | 364 | 0x80000004 | 0x6070   |
| 172.17.0.0    | 1.1.1.1    | 145 | 0x80000003 | 0xD8B7   |
| 172.18.0.0    | 1.1.1.1    | 116 | 0x80000004 | 0x4886   |
| 192.168.203.0 | 1.1.1.1    | 121 | 0x80000001 | 0x23FF   |

CHE #

### HYD-1 – Verification:

HYD-1 # show ip ospf neighbor

| Neighbor ID | Pri | State   | Dead Time | Address    | Interface   |
|-------------|-----|---------|-----------|------------|-------------|
| 3.3.3.3     | 0   | FULL/ - | 00:00:32  | 172.17.0.2 | Serial0/0/0 |
| 1.1.1.1     | 0   | FULL/ - | 00:00:31  | 172.16.0.1 | Serial0/0/1 |

HYD-1 #



HYD-1 # show ip ospf database

OSPF Router with ID (2.2.2.2) (Process ID 2)

Router Link States (Area 0)

| Link ID | ADV Router | Age | Seq#       | Checksum | Link count |
|---------|------------|-----|------------|----------|------------|
| 1.1.1.1 | 1.1.1.1    | 56  | 0x80000005 | 0x385F   | 4          |
| 2.2.2.2 | 2.2.2.2    | 48  | 0x80000005 | 0xD3A9   | 5          |
| 3.3.3.3 | 3.3.3.3    | 46  | 0x80000004 | 0x87B    | 4          |

Summary Net Link States (Area 0)

| Link ID       | ADV Router | Age | Seq#       | Checksum |
|---------------|------------|-----|------------|----------|
| 192.168.201.0 | 1.1.1.1    | 586 | 0x80000001 | 0x655    |
| 192.168.203.0 | 3.3.3.3    | 586 | 0x80000001 | 0x655    |

HYD-1 #

### BAN – Verification:

BAN # show ip ospf neighbor

| Neighbor ID | Pri | State   | Dead Time | Address    | Interface |
|-------------|-----|---------|-----------|------------|-----------|
| 1.1.1.1     | 1   | FULL/ - | 00:00:39  | 172.18.0.2 | Serial0/0 |
| 2.2.2.2     | 1   | FULL/ - | 00:00:33  | 172.17.0.1 | Serial0/1 |

BAN #

BAN # show ip ospf database

OSPF Router with ID (3.3.3.3) (Process ID 3)

Router Link States (Area 0)

| Link ID | ADV Router | Age | Seq#       | Checksum | Link count |
|---------|------------|-----|------------|----------|------------|
| 1.1.1.1 | 1.1.1.1    | 56  | 0x80000005 | 0x385F   | 4          |
| 2.2.2.2 | 2.2.2.2    | 48  | 0x80000005 | 0xD3A9   | 5          |
| 3.3.3.3 | 3.3.3.3    | 46  | 0x80000004 | 0x87B    | 4          |

Summary Net Link States (Area 0)

| Link ID       | ADV Router | Age | Seq#       | Checksum |
|---------------|------------|-----|------------|----------|
| 192.168.201.0 | 1.1.1.1    | 586 | 0x80000001 | 0x655    |
| 192.168.203.0 | 1.1.1.1    | 586 | 0x80000001 | 0x655    |

## Router Link States (Area 2)

| Link ID | ADV Router | Age | Seq#       | Checksum | Link count |
|---------|------------|-----|------------|----------|------------|
| 3.3.3.3 | 3.3.3.3    | 596 | 0x80000001 | 0x4B98   | 1          |

## Summary Net Link States (Area 2)

| Link ID       | ADV Router | Age | Seq#       | Checksum |
|---------------|------------|-----|------------|----------|
| 192.168.202.0 | 3.3.3.3    | 379 | 0x80000001 | 0x7312   |
| 172.16.0.0    | 3.3.3.3    | 364 | 0x80000004 | 0x6070   |
| 172.17.0.0    | 3.3.3.3    | 145 | 0x80000003 | 0xD8B7   |
| 172.18.0.0    | 3.3.3.3    | 116 | 0x80000004 | 0x4886   |
| 192.168.203.0 | 3.3.3.3    | 121 | 0x80000001 | 0x23FF   |

BAN #



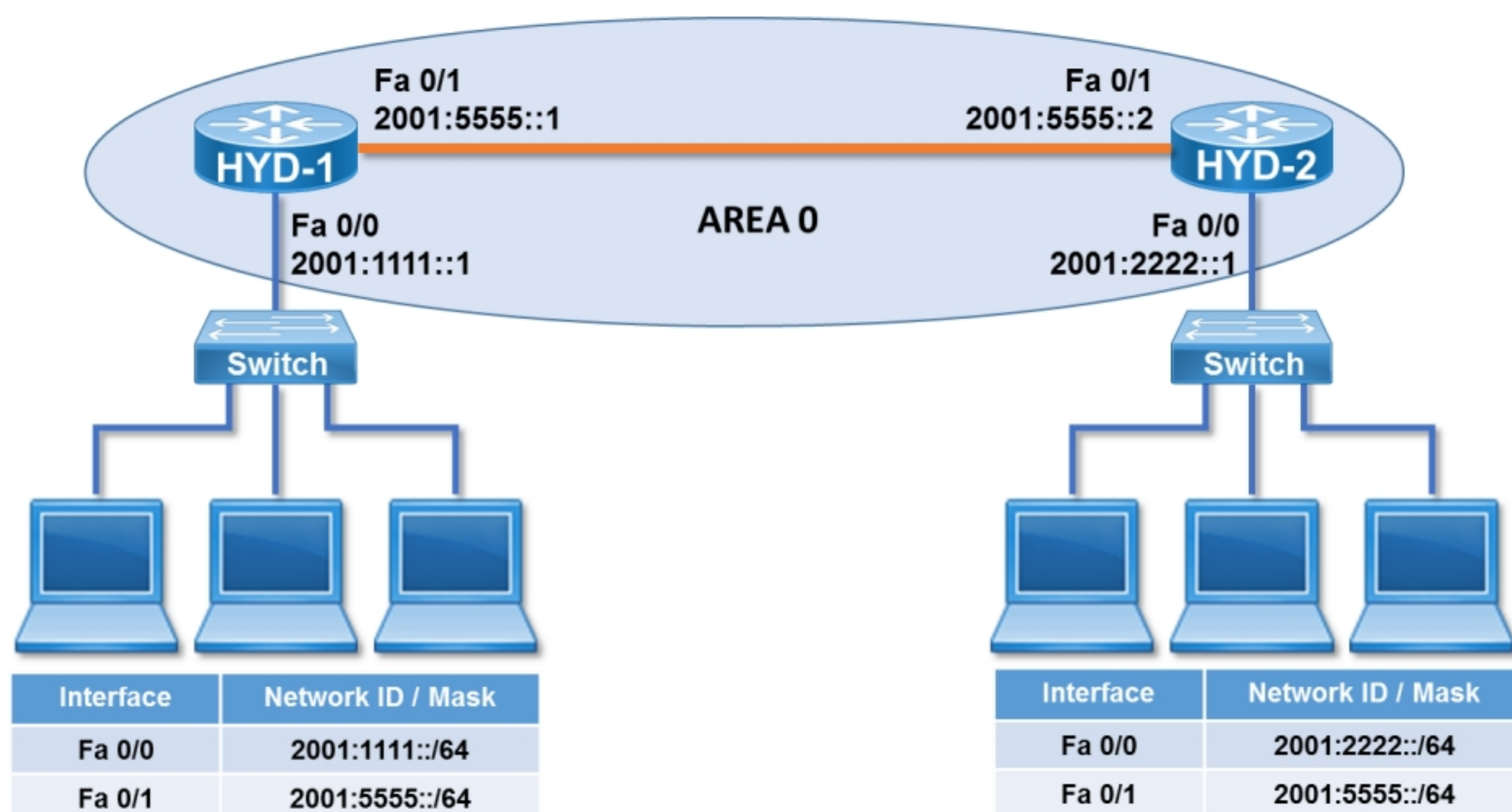
## LAB 14: OSPFv3 ON IPv6 NETWORK

### OBJECTIVE:

To configure OSPFv3 Routing in a single area.

### TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below:



**Pre-requisite: WAN Interface configuration to be done on the router (LAB – 6)**

### TASK:

- Configure OSPFv3 on IPv6 network
- Verify OSPFv3 on IPv6 network
- Verify communication between the IPv6 networks
- Verify OSPFv3 Neighbor and Topology Table on IPv6 network

## Configure OSPFv3 on IPv6 Network

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ipv6 unicast-routing**

HYD-1 (config) # **ipv6 router ospf 2**

HYD-1 (config-rtr) # **router-id 11.11.11.11**

HYD-1 (config-rtr) # **exit**

HYD-1 (config) # **interface fastethernet 0/0**

HYD-1 (config-if) # **ipv6 ospf 2 area 0**

HYD-1 (config-if) # **exit**

HYD-1 (config) # **interface fastethernet 0/1**

HYD-1 (config-if) # **ipv6 ospf 2 area 0**

HYD-1 (config-if) # **end**

HYD-1 #

### HYD-2 – Configuration

HYD-2 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-2 (config) # **ipv6 unicast-routing**

HYD-2 (config) # **ipv6 router ospf 2**

HYD-2 (config-rtr) # **router-id 22.22.22.22**

HYD-2 (config-rtr) # **exit**

HYD-2 (config) # **interface fastethernet 0/0**

HYD-2 (config-if) # **ipv6 ospf 2 area 0**

HYD-2 (config-if) # **exit**

HYD-2 (config) # **interface fastethernet 0/1**

HYD-2 (config-if) # **ipv6 ospf 2 area 0**

HYD-2 (config-if) # **end**

HYD-2 #



## Verify OSPFv3 on IPv6 Network

Once OSPF routing is enabled, IPv6 Networks learnt via **OSPF** are added into the routing table. “O” represents **OSPF route**.

### HYD-1 – Verification:

HYD-1 # **show ip route**

IPv6 Routing Table - default - 6 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP

D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2

```
C 2001:1111::/64 [0/0]
  via FastEthernet0/0, directly connected
L 2001:1111::1/128 [0/0]
  via FastEthernet0/0, receive
O 2001:2222::/64 [110/2]
  via FE80::21C:F6FF:FE85:1FA1, FastEthernet0/1
C 2001:5555::/64 [0/0]
  via FastEthernet0/1, directly connected
L 2001:5555::1/128 [0/0]
  via FastEthernet0/1, receive
L FF00::/8 [0/0]
  via Null0, receive
HYD-1 #
```

### HYD-2 – Verification:

HYD-2 # **show ipv6 route**

IPv6 Routing Table - default - 6 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP

D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2

```
O 2001:1111::/64 [110/2]
  via FE80::21B:2AFF:FEA4:2FE9, FastEthernet0/1
C 2001:2222::/64 [0/0]
  via FastEthernet0/0, directly connected
L 2001:2222::1/128 [0/0]
  via FastEthernet0/0, receive
C 2001:5555::/64 [0/0]
  via FastEthernet0/1, directly connected
L 2001:5555::2/128 [0/0]
  via FastEthernet0/1, receive
L FF00::/8 [0/0]
  via Null0, receive
HYD-2#
```

## Verify communication between the IPv6 networks

### Verification from a Computer in HYD-1 Network

**ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)**

```
PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=62 time=0.336 ms
```

### Verification from a Computer in HYD-2 Network

**ping 2001:1111::10 (Windows) or ping6 2001:1111::10 (Linux)**

```
PING 2001:1111::10(2001:1111::10) 56 data bytes
64 bytes from 2001:1111::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:1111::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:1111::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:1111::10: icmp_seq=4 ttl=62 time=0.336 ms
```

### From a Computer in HYD-1 Network trace communication path to a Computer in HYD-2 Network

**tracert 2001:2222::10 (Windows) or traceroute6 2001:2222::10 (Linux)**

```
traceroute to 2001:2222::10 (2001:2222::10), 30 hops max, 80 byte packets
 1  2001:1111::1 (2001:1111::1)  2.825 ms  3.239 ms  3.665 ms
 2  2001:5555::2 (2001:5555::2)  9.086 ms  9.393 ms  9.642 ms
 3  2001:2222::10 (2001:2222::10)  9.781 ms  10.474 ms  10.720 ms
```

### From a Computer in HYD-2 Network trace communication path to a Computer in HYD-1 Network

**tracert 2001:1111::10 (Windows) or traceroute6 2001:1111::10 (Linux)**

```
traceroute to 2001:1111::10 (2001:1111::10), 30 hops max, 80 byte packets
 1  2001:2222::1 (2001:2222::1)  1.071 ms  1.152 ms  1.238 ms
 2  2001:5555::1 (2001:5555::1)  4.303 ms  4.930 ms  5.419 ms
 3  2001:1111::10 (2001:1111::10)  10.832 ms  11.444 ms  11.541 ms
```



## Verify OSPF Neighbour and Database Table on IPv6 Network

### HYD-1 – Verification:

HYD-1 # **show ipv6 ospf neighbor**

| Neighbor ID | Pri | State   | Dead Time | Interface ID | Interface       |
|-------------|-----|---------|-----------|--------------|-----------------|
| 22.22.22.22 | 1   | FULL/DR | 00:00:34  | 4            | FastEthernet0/1 |

HYD-1 #

HYD-1 # **show ipv6 ospf database**

OSPFv3 Router with ID (11.11.11.11) (Process ID 2)

#### Router Link States (Area 0)

| ADV Router  | Age | Seq#       | Fragment ID | Link count | Bits |
|-------------|-----|------------|-------------|------------|------|
| 11.11.11.11 | 234 | 0x80000002 | 0           | 1          | None |
| 22.22.22.22 | 233 | 0x80000002 | 0           | 1          | None |

#### Net Link States (Area 0)

| ADV Router  | Age | Seq#       | Link ID | Rtr count |
|-------------|-----|------------|---------|-----------|
| 22.22.22.22 | 233 | 0x80000001 | 4       | 2         |

HYD-2#

### HYD-2 – Verification:

HYD-2 # **show ipv6 ospf neighbor**

| Neighbor ID | Pri | State    | Dead Time | Interface ID | Interface       |
|-------------|-----|----------|-----------|--------------|-----------------|
| 11.11.11.11 | 1   | FULL/BDR | 00:00:34  | 4            | FastEthernet0/1 |

HYD-2 #

HYD-2 # **show ipv6 ospf database**

OSPFv3 Router with ID (22.22.22.22) (Process ID 2)

#### Router Link States (Area 0)

| ADV Router  | Age | Seq#       | Fragment ID | Link count | Bits |
|-------------|-----|------------|-------------|------------|------|
| 11.11.11.11 | 234 | 0x80000002 | 0           | 1          | None |
| 22.22.22.22 | 233 | 0x80000002 | 0           | 1          | None |

#### Net Link States (Area 0)

| ADV Router  | Age | Seq#       | Link ID | Rtr count |
|-------------|-----|------------|---------|-----------|
| 22.22.22.22 | 233 | 0x80000001 | 4       | 2         |

HYD-2#

## LAB 15: EIGRP ON IPv4 network

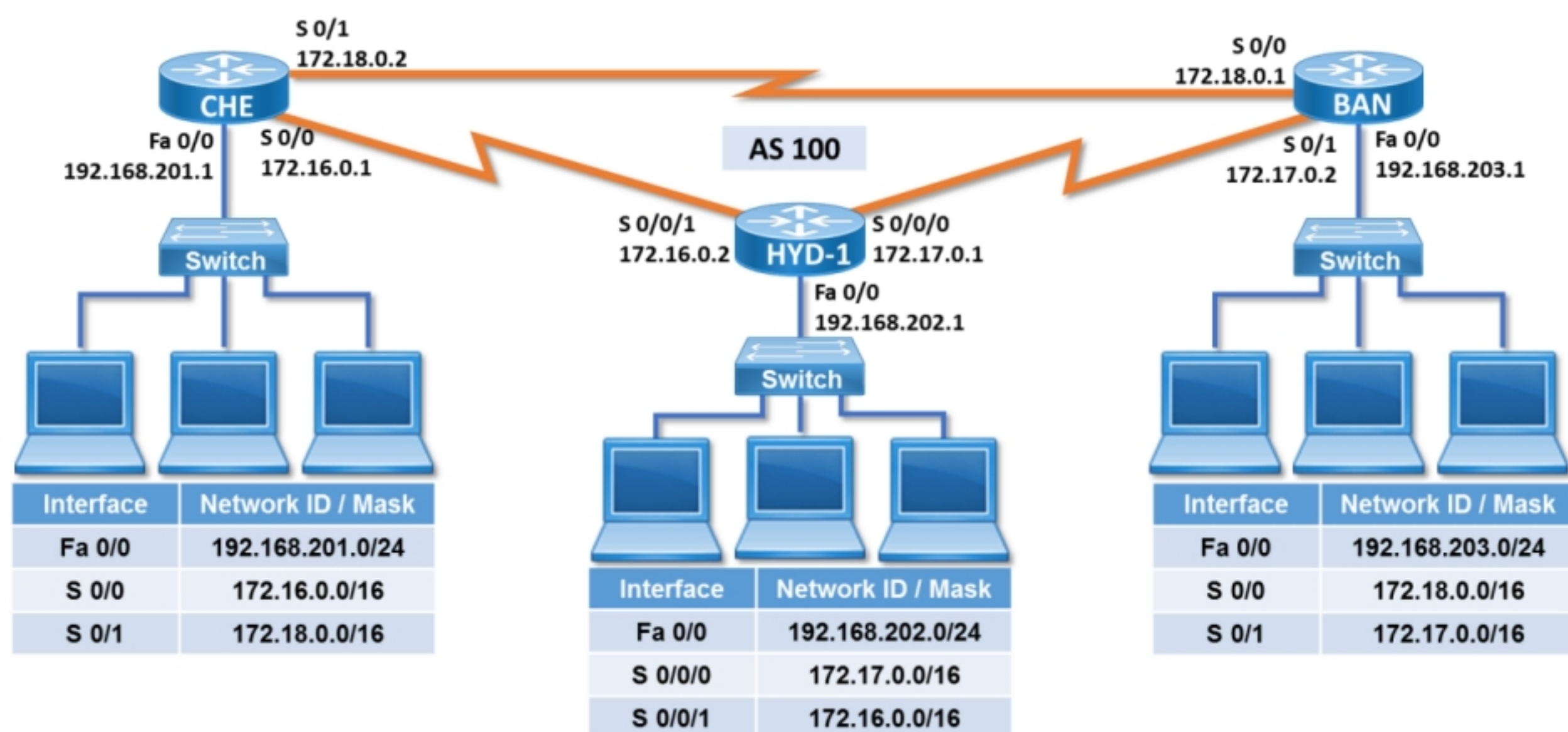
### OBJECTIVE:

To configure EIGRP for communicating between different IPv4 networks on different routers.

To understand how EIGRP works and fine tune EIGRP configuration.

### TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



**Pre-requisite: WAN Interface configuration to be done on the router (LAB – 6)**

### TASK:

- Configure EIGRP Routing on IPv4 network
- Verify EIGRP Routing on IPv4 network
- Verify Communication between the IPv4 networks
- Verify EIGRP Neighbour and Topology Table on IPv4 networks
- Verify EIGRP protocol default settings
- Verify EIGRP Packets
- Enable Passive Interface on EIGRP
- Verify interfaces configured for EIGRP



## Configure EIGRP Routing on IPv4 network

### CHE – Configuration

CHE # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

CHE (config) # **ip routing**

CHE (config) # **router eigrp 100**

CHE (config-router) # **network 192.168.201.0 0.0.0.255**

CHE (config-router) # **network 172.16.0.0 0.0.255.255**

CHE (config-router) # **network 172.18.0.0 0.0.255.255**

CHE (config-router) # **end**

CHE #

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ip routing**

HYD-1 (config) # **router eigrp 100**

HYD-1 (config-router) # **network 192.168.202.0 0.0.0.255**

HYD-1 (config-router) # **network 172.16.0.0 0.0.255.255**

HYD-1 (config-router) # **network 172.17.0.0 0.0.255.255**

HYD-1 (config-router) # **end**

HYD-1 #

### BAN – Configuration

BAN # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

BAN (config) # **ip routing**

BAN (config) # **router eigrp 100**

BAN (config-router) # **network 192.168.203.0 0.0.0.255**

BAN (config-router) # **network 172.17.0.0 0.0.255.255**

BAN (config-router) # **network 172.18.0.0 0.0.255.255**

BAN (config-router) # **end**

BAN #

## Verify EIGRP Routing

Once EIGRP routing is enabled, IPv4 Networks learnt via **EIGRP** are added into the routing table. “D” represents **EIGRP route**.

### CHE – Verification:

#### CHE # show ip route

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
 i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area  
 \* - candidate default, U - per-user static route, o - ODR  
 P - periodic downloaded static route

Gateway of last resort is not set

```
D 172.17.0.0/16 [90/2681856] via 172.16.0.2, 00:02:18, Serial0/0
    [90/2681856] via 172.18.0.1, 00:02:18, Serial0/1
C 172.16.0.0/16 is directly connected, Serial0/0
C 172.18.0.0/16 is directly connected, Serial0/1
C 192.168.201.0/24 is directly connected, FastEthernet0/0
D 192.168.202.0/24 [90/2172416] via 172.16.0.2, 00:02:18, Serial0/0
D 192.168.203.0/24 [90/2172416] via 172.18.0.1, 00:02:18, Serial0/1
CHE #
```

### HYD-1 – Verification:

#### HYD-1 # show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 E1 - OSPF external type 1, E2 - OSPF external type 2  
 ia - IS-IS inter area, \* - candidate default, U - per-user static route  
 o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP  
 + - replicated route, % - next hop override

Gateway of last resort is not set

```
172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.16.0.0/16 is directly connected, Serial0/0/1
L 172.16.0.2/32 is directly connected, Serial0/0/1
172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.17.0.0/16 is directly connected, Serial0/0/0
L 172.17.0.1/32 is directly connected, Serial0/0/0
D 172.18.0.0/16 [90/2681856] via 172.17.0.2, 00:02:53, Serial0/0/0
    [90/2681856] via 172.16.0.1, 00:02:53, Serial0/0/1
D 192.168.201.0/24 [90/2172416] via 172.16.0.1, 00:02:48, Serial0/0/1
192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.202.0/24 is directly connected, FastEthernet0/0
L 192.168.202.1/32 is directly connected, FastEthernet0/0
D 192.168.203.0/24 [90/2172416] via 172.17.0.2, 00:02:50, Serial0/0/0
HYD-1#
```



**BAN – Verification:****BAN # show ip route**

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, \* - candidate default, U - per-user static route  
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

```
C 172.17.0.0/16 is directly connected, Serial0/1
D 172.16.0.0/16 [90/2681856] via 172.17.0.1, 00:03:17, Serial0/1
  [90/2681856] via 172.18.0.2, 00:03:17, Serial0/0
C 172.18.0.0/16 is directly connected, Serial0/0
D 192.168.201.0/24 [90/2172416] via 172.18.0.2, 00:03:17, Serial0/0
D 192.168.202.0/24 [90/2172416] via 172.17.0.1, 00:03:17, Serial0/1
C 192.168.203.0/24 is directly connected, FastEthernet0/0
BAN#
```

**Verify communication between the IPv4 networks****Verification from a Computer in HYD-1 Network****ping 192.168.201.10**

```
PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=4 ttl=62 time=24.0 ms
```

**ping 192.168.203.10**

```
PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms
```

**Repeat the above ping verification from a computer in CHE and BAN Network.**

### From a Computer in HYD-1 Network trace communication path to a Computer in CHE Network

```
tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)
traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets
 1  192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2  172.16.0.1 (172.16.0.1)  2.295 ms  2.156 ms  2.209 ms
 3  192.168.201.10 (192.168.202.10)  3.295 ms  3.156 ms  3.209 ms
```

### From a Computer in HYD-1 Network trace communication path to a Computer in BAN Network

```
tracert 192.168.203.10 (Windows) or traceroute 192.168.203.10 (Linux)
traceroute to 192.168.203.10 (192.168.203.10), 30 hops max, 38 byte packets
 1  192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2  172.17.0.2 (172.17.0.2)  2.295 ms  2.156 ms  2.209 ms
 3  192.168.203.10 (192.168.203.10)  3.295 ms  3.156 ms  3.209 ms
```

**Repeat the above trace communication path from a computer in CHE and BAN Network.**

### Verify EIGRP Neighbour and Topology Table on IPv4 Network

#### CHE – Verification:

**CHE # show ip eigrp neighbor**

IP-EIGRP neighbors for process 100

| H | Address    | Interface<br>(sec) | Hold<br>(ms) | Uptime   | SRTT | RTO<br>Cnt | Q<br>Num | Seq | Type |
|---|------------|--------------------|--------------|----------|------|------------|----------|-----|------|
| 1 | 172.18.0.1 | Se0/1              | 13           | 00:02:22 | 28   | 200        | 0        | 6   |      |
| 0 | 172.16.0.2 | Se0/0              | 11           | 00:03:29 | 27   | 200        | 0        | 10  |      |

CHE#

**CHE # show ip eigrp topology**

IP-EIGRP Topology Table for AS(10)/ID(192.168.201.1)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,  
r - Reply status

P 192.168.201.0/24, 1 successors, FD is 281600  
via Connected, FastEthernet0/0

P 192.168.202.0/24, 1 successors, FD is 2172416  
via 172.16.0.2 (2172416/28160), Serial0/0

P 192.168.203.0/24, 1 successors, FD is 2172416  
via 172.18.0.1 (2172416/28160), Serial0/1

P 172.16.0.0/16, 1 successors, FD is 2169856  
via Connected, Serial0/0

P 172.17.0.0/16, 2 successors, FD is 2681856  
via 172.18.0.1 (2681856/2169856), Serial0/1  
via 172.16.0.2 (2681856/2169856), Serial0/0

P 172.18.0.0/16, 1 successors, FD is 2169856  
via Connected, Serial0/1

CHE#



### HYD-1 – Verification:

#### HYD-1 # show ip eigrp neighbor

EIGRP-IPv4 Neighbors for AS(100)

| H | Address    | Interface<br>(sec) | Hold | Uptime<br>(ms) | SRTT | RTO<br>Cnt | Q<br>Num | Seq | Type |
|---|------------|--------------------|------|----------------|------|------------|----------|-----|------|
| 1 | 172.16.0.1 | Se0/0/1            | 13   | 01:06:11       | 28   | 200        | 0        | 7   |      |
| 0 | 172.17.0.2 | Se0/0/0            | 14   | 01:09:47       | 26   | 200        | 0        | 10  |      |

HYD-1#

#### HYD-1 # show ip eigrp topology

EIGRP-IPv4 Topology Table for AS(100)/ID(192.168.202.1)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,  
r - reply Status, s - sia Status

P 192.168.203.0/24, 1 successors, FD is 2172416  
via 172.17.0.2 (2172416/28160), Serial0/0/0

P 172.16.0.0/16, 1 successors, FD is 2169856  
via Connected, Serial0/0/1

P 172.18.0.0/16, 2 successors, FD is 2681856  
via 172.16.0.1 (2681856/2169856), Serial0/0/1  
via 172.17.0.2 (2681856/2169856), Serial0/0/0

P 172.17.0.0/16, 1 successors, FD is 2169856  
via Connected, Serial0/0/0

P 192.168.201.0/24, 1 successors, FD is 2195456  
via 172.16.0.1 (2195456/281600), Serial0/0/1

P 192.168.202.0/24, 1 successors, FD is 28160  
via Connected, FastEthernet0/0

HYD-1#

### BAN – Verification:

#### BAN # show ip eigrp neighbor

IP-EIGRP neighbors for process 100

| H | Address    | Interface<br>(sec) | Hold | Uptime<br>(ms) | SRTT | RTO<br>Cnt | Q<br>Num | Seq | Type |
|---|------------|--------------------|------|----------------|------|------------|----------|-----|------|
| 1 | 172.17.0.1 | Se0/1              | 13   | 00:00:53       | 69   | 200        | 0        | 11  |      |
| 0 | 172.18.0.2 | Se0/0              | 13   | 00:01:02       | 411  | 2466       | 0        | 12  |      |

BAN#

#### BAN # show ip eigrp topology

IP-EIGRP Topology Table for AS(100)/ID(192.168.203.1)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,  
r - reply Status, s - sia Status

P 192.168.201.0/24, 1 successors, FD is 2195456  
via 172.18.0.2 (2172416/28160), Serial0/0

P 192.168.202.0/24, 1 successors, FD is 2172416  
via 172.17.0.1 (2172416/28160), Serial0/1

```
P 192.168.203.0/24, 1 successors, FD is 28160
  via Connected, FastEthernet0/0
P 172.16.0.0/16, 2 successors, FD is 2681856
  via 172.18.0.2 (2681856/2169856), Serial0/0
  via 172.17.0.1 (2681856/2169856), Serial0/1
P 172.17.0.0/16, 1 successors, FD is 2169856
  via Connected, Serial0/1
P 172.18.0.0/16, 1 successors, FD is 2169856
  via Connected, Serial0/0
BAN#
```

### Verify EIGRP protocol default settings

#### Example - HYD-1

HYD-1 # **show ip protocols**

Routing Protocol is "eigrp 100"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Default networks flagged in outgoing updates

Default networks accepted from incoming updates

EIGRP-IPv4 Protocol for AS(100)

Metric weight K1=1, K2=0, K3=1, K4=0, K5=0

NSF-aware route hold timer is 240

Router-ID: 192.168.202.1

Topology : 0 (base)

Active Timer: 3 min

Distance: internal 90 external 170

Maximum path: 4

Maximum hopcount 100

Maximum metric variance 1

Automatic Summarization: Enabled

Maximum path: 4

Routing for Networks:

172.16.0.0

172.17.0.0

192.168.202.0

Routing Information Sources:

| Gateway    | Distance | Last Update |
|------------|----------|-------------|
| 172.16.0.1 | 90       | 00:00:41    |
| 172.17.0.2 | 90       | 00:00:41    |

Distance: internal 90 external 170

R2#



## Verify EIGRP Packets

Verify default behaviour of EIGRP Hello / Update packets by enabling debug commands

### Example - HYD-1

HYD-1 # **terminal monitor**

HYD-1 # **debug eigrp packet**

(UPDATE, REQUEST, QUERY, REPLY, HELLO, IPXSAP, PROBE, ACK, STUB, SIAQUERY, SIAREPLY)

EIGRP Packet debugging is on

```
*Jul 21 17:57:04.245: EIGRP: Packet from ourselves ignored
*Jul 21 17:57:04.861: EIGRP: Sending HELLO on Serial0/0/0
*Jul 21 17:57:04.861: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ un/rely 0/0
*Jul 21 17:57:04.909: EIGRP: Sending HELLO on Serial0/0/1
*Jul 21 17:57:04.909: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ un/rely 0/0
*Jul 21 17:57:04.917: EIGRP: Received HELLO on Serial0/0/1 nbr 172.16.0.1
*Jul 21 17:57:04.917: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ un/rely 0/0 peerQ
un/rely 0/0
*Jul 21 17:57:05.621: EIGRP: Received HELLO on Serial0/0/0 nbr 172.17.0.2
*Jul 21 17:57:05.621: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ un/rely 0/0 peerQ
un/rely 0/0
*Jul 21 17:57:05.793: EIGRP: Received HELLO on FastEthernet0/0 nbr 192.168.203.1
*Jul 21 17:57:05.793: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0
*Jul 21 17:57:05.793: EIGRP-IPv4(10): Neighbor 192.168.203.1 not on common subnet for
GigabitEthernet0/0
*Jul 21 17:57:06.949: EIGRP: Received HELLO on FastEthernet0/0 nbr 192.168.202.1
*Jul 21 17:57:06.949: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0
*Jul 21 17:57:07.317: EIGRP: Sending HELLO on Loopback1
*Jul 21 17:57:07.317: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ un/rely 0/0
*Jul 21 17:57:07.317: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0
*Jul 21 17:57:07.317: EIGRP: Packet from ourselves ignored
*Jul 21 17:57:07.409: EIGRP: Sending HELLO on FastEthernet0/0
*Jul 21 17:57:07.409: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ un/rely 0/0
!
<output omitted>
!
*Jul 21 17:57:12.109: EIGRP: Packet from ourselves ignored
*Jul 21 17:57:12.201: EIGRP: Sending HELLO on FastEthernet0/0
*Jul 21 17:57:12.201: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ un/rely 0/0
```

HYD-1 # **undebg all**

HYD-1 # **terminal no monitor**

## Enabling Passive Interface on EIGRP

To disable sending of EIGRP hello / updates packet on selected Interface. (i.e. Ethernet Interface) we use the passive interface command.

### Example - HYD-1

HYD-1# **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **router eigrp 100**

HYD-1 (config-router) # **passive-interface FastEthernet0/0**

HYD-1 (config-router) # **end**

### HYD-1 – Verification:

HYD-1 # **show ip protocols**

Routing Protocol is "eigrp 100"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

EIGRP-IPv4 Protocol for AS(100)

Metric weight K1=1, K2=0, K3=1, K4=0, K5=0

NSF-aware route hold timer is 240

Router-ID: 192.168.202.1

Topology : 0 (base)

Distance: internal 90 external 170

Maximum path: 4

Maximum hopcount 100

Maximum metric variance 1

Automatic Summarization: Enabled

Maximum path: 4

Routing for Networks:

172.16.0.0

172.17.0.0

192.168.202.0

Passive Interface(s):

FastEthernet0/0

Routing Information Sources:

| Gateway | Distance | Last Update |
|---------|----------|-------------|
|---------|----------|-------------|

|            |    |          |
|------------|----|----------|
| 172.16.0.1 | 90 | 00:00:41 |
|------------|----|----------|

|            |    |          |
|------------|----|----------|
| 172.17.0.2 | 90 | 00:00:41 |
|------------|----|----------|

Distance: internal 90 external 170

R2#

After enabling passive interface, again verify the behaviour of EIGRP Hello / Update packets by enabling debug commands. Now you will not see the following line in the debug outputs.

### **EIGRP: Sending HELLO on FastEthernet0/0**

This means you have successfully disabled sending of EIGRP hello / updates packet on selected Interface.



## Configuring Router ID

### Example - HYD-1

HYD-1# **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **router eigrp 100**

HYD-1 (config-router) # **eigrp router-id 2.2.2.2**

HYD-1 (config-router) # **end**

### HYD-1 – Verification:

HYD-1 # **show ip eigrp topology**

EIGRP-IPv4 Topology Table for AS(100)/ID(2.2.2.2)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,  
r - reply Status, s - sia Status

```
P 192.168.203.0/24, 1 successors, FD is 2172416
  via 172.17.0.2 (2172416/28160), Serial0/0/0
P 172.16.0.0/16, 1 successors, FD is 2169856
  via Connected, Serial0/0/1
P 172.18.0.0/16, 2 successors, FD is 2681856
  via 172.16.0.1 (2681856/2169856), Serial0/0/1
  via 172.17.0.2 (2681856/2169856), Serial0/0/0
P 172.17.0.0/16, 1 successors, FD is 2169856
  via Connected, Serial0/0/0
P 192.168.201.0/24, 1 successors, FD is 2195456
  via 172.16.0.1 (2195456/281600), Serial0/0/1
P 192.168.202.0/24, 1 successors, FD is 28160
  via Connected, FastEthernet0/0
HYD-1#
```

### Verify interfaces configured for EIGRP

HYD-1 # **show ip eigrp interfaces**

EIGRP-IPv4 Interfaces for AS(100)

| Interface | Peers | Xmit Queue<br>Un/Reliable | Mean<br>SRTT | Pacing Time<br>Un/Reliable | Multicast<br>Flow Timer | Pending<br>Routes |
|-----------|-------|---------------------------|--------------|----------------------------|-------------------------|-------------------|
| Se0/0/1   | 1     | 0/0                       | 487          | 0/15                       | 2431                    | 0                 |
| Se0/0/0   | 1     | 0/0                       | 32           | 0/15                       | 155                     | 0                 |
| Fa0/0     | 0     | 0/0                       | 0            | 0/1                        | 0                       | 0                 |

HYD-1 #

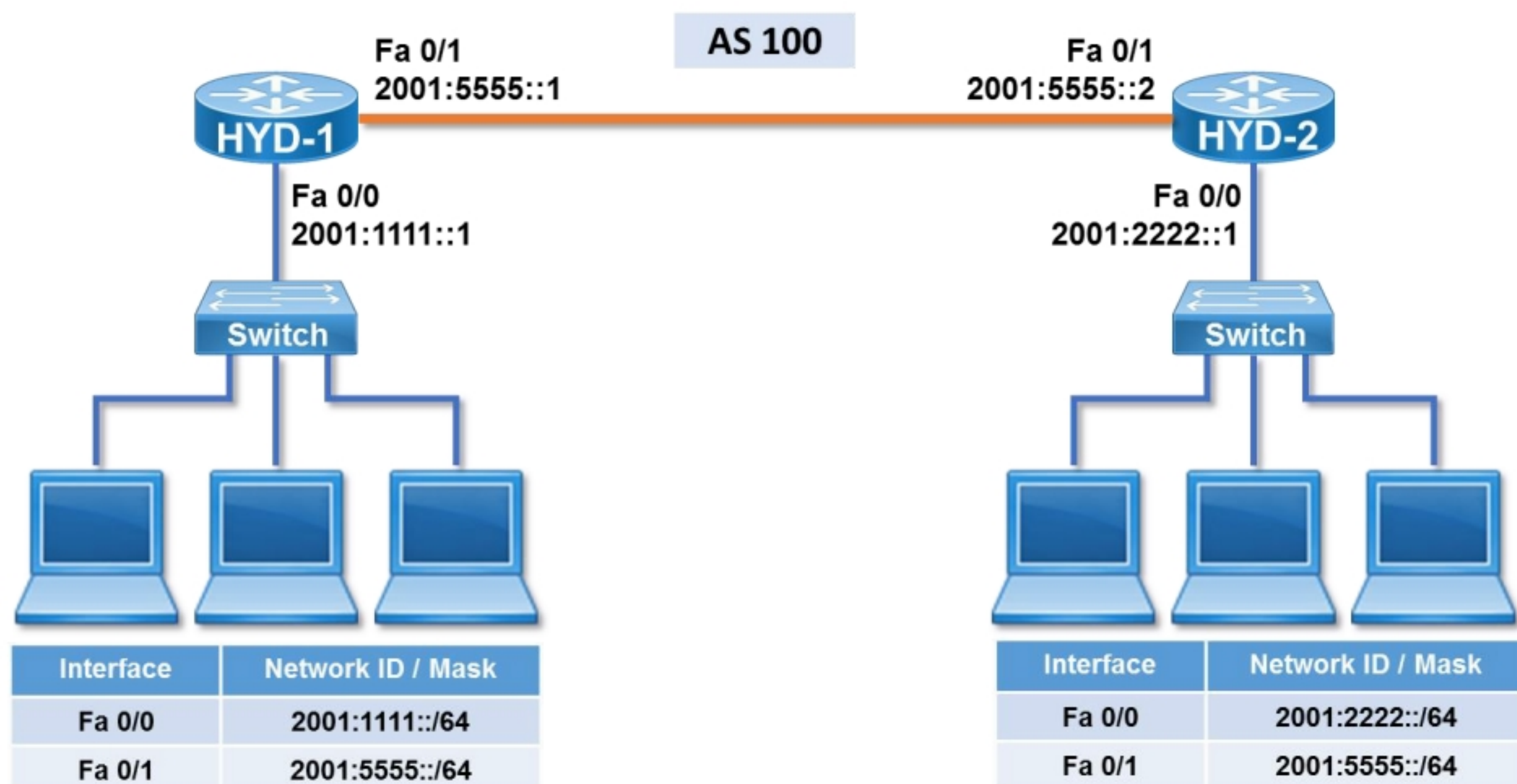
## LAB 16: EIGRPv6 ON IPv6 NETWORK

### OBJECTIVE:

To configure EIGRPv6 routing for communicating between different IPv6 networks on different routers.

### TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



**Pre-requisite:** WAN Interface configuration to be done on the router (LAB – 7)

### TASK:

- Configure EIGRPv6 on IPv6 Network
- Verify EIGRPv6 on IPv6 Network
- Verify Communication between the IPv6 networks
- Verify EIGRP Neighbour and Topology Table on IPv6 networks



## Configure EIGRPv6 on IPv6 Network

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ipv6 unicast-routing**

HYD-1 (config) # **ipv6 router eigrp 100**

HYD-1 (config-rtr) # **eigrp router-id 11.11.11.11**

HYD-1 (config-rtr) # **exit**

HYD-1 (config) # **interface fastethernet 0/0**

HYD-1 (config-if) # **ipv6 eigrp 100**

HYD-1 (config-if) # **exit**

HYD-1 (config) # **interface fastethernet 0/1**

HYD-1 (config-if) # **ipv6 eigrp 100**

HYD-1 (config-if) # **end**

HYD-1 #

### HYD-2 – Configuration

HYD-2 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-2 (config) # **ipv6 unicast-routing**

HYD-2 (config) # **ipv6 router eigrp 100**

HYD-2 (config-rtr) # **eigrp router-id 22.22.22.22**

HYD-2 (config-rtr) # **exit**

HYD-2 (config) # **interface fastethernet 0/0**

HYD-2 (config-if) # **ipv6 eigrp 100**

HYD-2 (config-if) # **exit**

HYD-2 (config) # **interface fastethernet 0/1**

HYD-2 (config-if) # **ipv6 eigrp 100**

HYD-2 (config-if) # **end**

HYD-2 #

## Verify EIGRPv6 on IPv6 Network

Once EIGRP routing is enabled, IPv6 Networks learnt via **EIGRP** are added into the routing table. “D” represents **EIGRP route**.

### HYD-1 – Verification:

HYD-1 # **show ip route**

IPv6 Routing Table - default - 6 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP

D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2

```
C 2001:1111::/64 [0/0]
  via FastEthernet0/0, directly connected
L 2001:1111::1/128 [0/0]
  via FastEthernet0/0, receive
D 2001:2222::/64 [90/30720]
  via FE80::21C:F6FF:FE85:1FA1, FastEthernet0/1
C 2001:5555::/64 [0/0]
  via FastEthernet0/1, directly connected
L 2001:5555::1/128 [0/0]
  via FastEthernet0/1, receive
L FF00::/8 [0/0]
  via Null0, receive
HYD-1 #
```

### HYD-2 – Verification:

HYD-2 # **show ipv6 route**

IPv6 Routing Table - default - 6 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP

D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2

```
D 2001:1111::/64 [90/30720]
  via FE80::21B:2AFF:FEA4:2FE9, FastEthernet0/1
C 2001:2222::/64 [0/0]
  via FastEthernet0/0, directly connected
L 2001:2222::1/128 [0/0]
  via FastEthernet0/0, receive
C 2001:5555::/64 [0/0]
  via FastEthernet0/1, directly connected
L 2001:5555::2/128 [0/0]
  via FastEthernet0/1, receive
L FF00::/8 [0/0]
  via Null0, receive
HYD-2#
```



## Verify communication between the IPv6 networks

### Verification from a Computer in HYD-1 Network

**ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)**

```
PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=62 time=0.336 ms
```

### Verification from a Computer in HYD-2 Network

**ping 2001:1111::10 (Windows) or ping6 2001:1111::10 (Linux)**

```
PING 2001:1111::10(2001:1111::10) 56 data bytes
64 bytes from 2001:1111::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:1111::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:1111::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:1111::10: icmp_seq=4 ttl=62 time=0.336 ms
```

### From a Computer in HYD-1 Network trace communication path to a Computer in HYD-2 Network

**tracert 2001:2222::10 (Windows) or traceroute6 2001:2222::10 (Linux)**

```
traceroute to 2001:2222::10 (2001:2222::10), 30 hops max, 80 byte packets
 1  2001:1111::1 (2001:1111::1)  2.825 ms  3.239 ms  3.665 ms
 2  2001:5555::2 (2001:5555::2)  9.086 ms  9.393 ms  9.642 ms
 3  2001:2222::10 (2001:2222::10)  9.781 ms  10.474 ms  10.720 ms
```

### From a Computer in HYD-2 Network trace communication path to a Computer in HYD-1 Network

**tracert 2001:1111::10 (Windows) or traceroute6 2001:1111::10 (Linux)**

```
traceroute to 2001:1111::10 (2001:1111::10), 30 hops max, 80 byte packets
 1  2001:2222::1 (2001:2222::1)  1.071 ms  1.152 ms  1.238 ms
 2  2001:5555::1 (2001:5555::1)  4.303 ms  4.930 ms  5.419 ms
 3  2001:1111::10 (2001:1111::10)  10.832 ms  11.444 ms  11.541 ms
```

## Verify EIGRP Neighbour and Topology Table on IPv6 Network

### HYD-1 – Verification:

HYD-1 # **show ip eigrp neighbour**

EIGRP-IPv6 Neighbors for AS(100)

| H | Address   | Interface | Hold<br>(sec) | Uptime   | SRTT | RTO<br>Cnt | Q<br>Num | Seq | Type |
|---|---|-----------|---------------|----------|------|------------|----------|-----|------|
| 0 | Link-local address:<br>FE80::21C:F6FF:FE85:1FA1 | Fa0/1     | 13            | 00:07:01 | 7    | 200        | 0        | 6   |      |

HYD-1 #

HYD-1 # **show ipv6 eigrp topology**

EIGRP-IPv6 Topology Table for AS(100)/ID(11.11.11.11)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,  
r - reply Status, s - sia Status

P 2001:2222::/64, 2 successors, FD is 30720  
via FE80::21C:F6FF:FE85:1FA1 (30720/28160), FastEthernet0/1

P 2001:1111::/64, 1 successors, FD is 28160  
via Connected, FastEthernet0/0

P 2001:5555::/64, 1 successors, FD is 28160  
via Connected, FastEthernet0/1

HYD-1 #

### HYD-2 – Verification:

HYD-2 # **show ip eigrp neighbors**

EIGRP-IPv6 Neighbors for AS(100)

| H | Address   | Interface | Hold<br>(sec) | Uptime   | SRTT | RTO<br>Cnt | Q<br>Num | Seq | Type |
|---|---|-----------|---------------|----------|------|------------|----------|-----|------|
| 0 | Link-local address:<br>FE80::21B:2AFF:FEA4:2FE9 | Fa0/1     | 13            | 00:07:01 | 7    | 200        | 0        | 6   |      |

HYD-1 #

HYD-2 # **show ipv6 eigrp topology**

EIGRP-IPv6 Topology Table for AS(100)/ID(22.22.22.22)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,  
r - reply Status, s - sia Status

P 2001:2222::/64, 1 successors, FD is 28160  
via Connected, FastEthernet0/0

P 2001:1111::/64, 2 successors, FD is 30720  
via FE80::21B:2AFF:FEA4:2FE9 (30720/28160), FastEthernet0/1

P 2001:5555::/64, 1 successors, FD is 28160  
via Connected, FastEthernet0/1

HYD-2 #



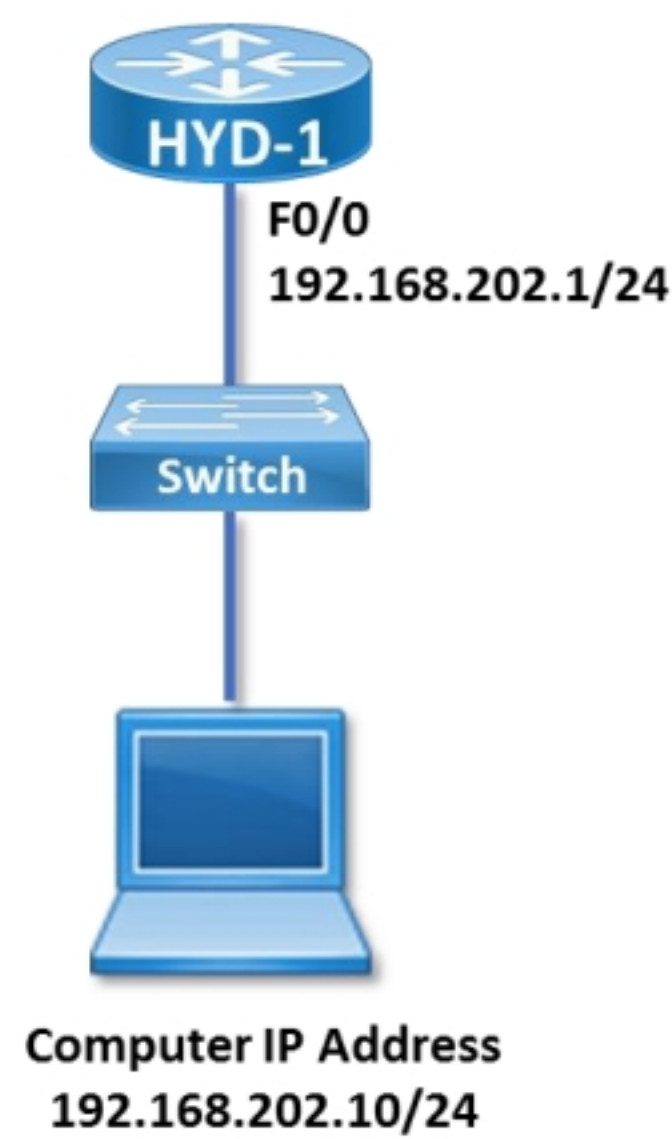
## LAB 17: SYSLOG

### OBJECTIVE:

To configure Logging on router and sending logs to a syslog server.

### TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



**Pre-requisite:** 192.168.202.10 computer should have Syslog server software installed and running.

### TASK:

- Configure logging to Syslog Server
- Configure logging to Buffer
- Generate and Verify Syslog Messages

## Configure Logging to Syslog Server

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **logging on**

HYD-1 (config) # **logging host 192.168.202.10**

HYD-1 (config) # **logging trap 7**

HYD-1 (config) # **exit**

HYD-1 #

## Configure Logging to Buffer

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **logging on**

HYD-1 (config) # **logging buffered 7**

HYD-1 (config) # **exit**

HYD-1 #

## Generate and Verify Syslog Messages

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **interface serial 0/0/0**

HYD-1 (config-if) # **shutdown**

HYD-1 (config-if) # **no shutdown**

HYD-1 (config-if) # **end**

HYD-1 #

### HYD-1 – Verification:

HYD-1 # **show logging**

Syslog logging: enabled (0 messages dropped, 3 messages rate-limited, 0 flushes, 0 overruns)

No Active Message Discriminator.

No Inactive Message Discriminator.

Console logging: disabled

Monitor logging: level debugging, 0 messages logged, xml disabled,  
filtering disabled

Buffer logging: level debugging, 7 messages logged, xml disabled,  
filtering disabled

Exception Logging: size (4096 bytes)

Count and timestamp logging messages: disabled

Persistent logging: disabled



No active filter modules.

Trap logging: level informational, 45 message lines logged

Logging to 192.168.202.10 (udp port 514, audit disabled, link up),

9 message lines logged,

0 message lines rate-limited,

0 message lines dropped-by-MD,

xml disabled, sequence number disabled

filtering disabled

Log Buffer (4096 bytes):

\*Jul 28 11:51:26.447: %SYS-5-CONFIG\_I: Configured from console by console

\*Jul 28 11:52:11.563: %LINK-5-CHANGED: Interface Serial0/0/0, changed state to administratively down

\*Jul 28 11:52:11.567: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to dn

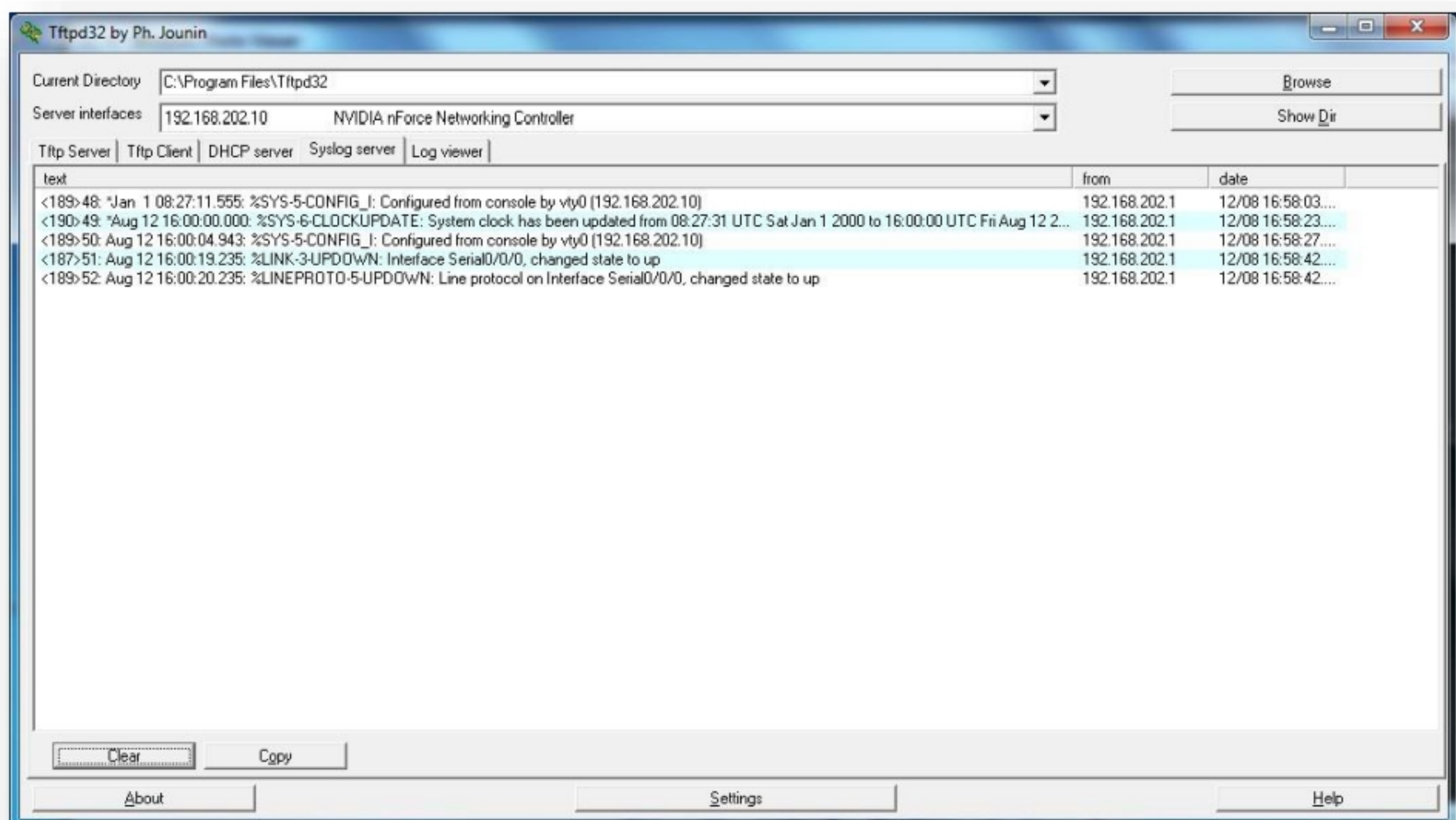
\*Jul 28 11:52:28.639: %SYS-5-CONFIG\_I: Configured from console by console

\*Jul 28 11:52:29.487: %LINK-3-UPDOWN: Interface Serial0/0/0, changed state to up

CHE #

### Verification on Syslog Server (PC) :

Start **Syslog software** to view the syslog's messages as below :



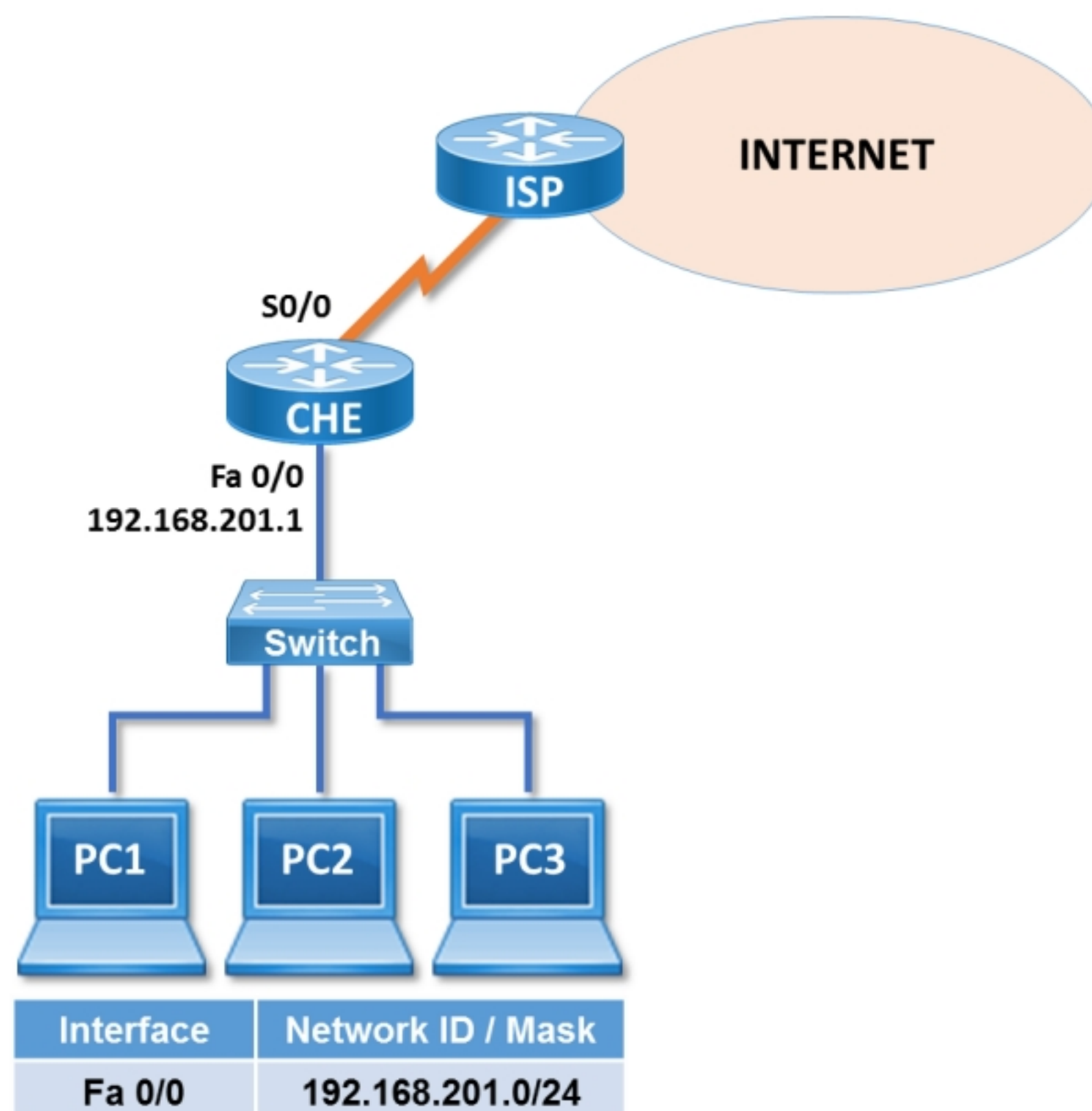
## LAB 18: NTP

### OBJECTIVE:

To configure router as NTP Client, for time synchronization with NTP server.

### TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



### TASK:

- Configure Date and Time – Manual
- Verify Current Date and Time
- Configure Router as NTP client
- Verify Date and time via NTP



## Configure Date and Time - Manual

### CHE – Configuration

CHE # clock set 13:36:30 10 Jan 2001

### Verify Current Date and Time

#### CHE – Verification:

CHE # show clock  
13:36:32.055 UTC Wed Jan 10 2001

## Configure Router as NTP client

### CHE – Configuration

CHE # configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
CHE (config) # ntp server 8.8.8.8  
CHE (config) # exit  
CHE #

### Verify Date and time via NTP

#### CHE – Verification:

CHE # show clock  
13:39:21.604 UTC Tue Aug 16 2016

#### CHE # show ntp status

Clock is synchronized, stratum 4, reference is 8.8.8.8  
nominal freq is 249.5901 Hz, actual freq is 249.5901 Hz, precision is 2\*\*18  
reference time is DB5D96BC.5E7B415C (13:42:20.369 UTC Tue Aug 16 2016)  
clock offset is 1.4590 msec, root delay is 32.53 msec  
root dispersion is 3878.63 msec, peer dispersion is 3876.77 msec

#### CHE # show ntp associations

| address   | ref clock   | st | when | poll | reach | delay | offset | disp   |
|-----------|-------------|----|------|------|-------|-------|--------|--------|
| *~8.8.8.8 | 127.127.1.1 | 3  | 17   | 64   | 7     | 32.5  | 1.46   | 3876.8 |

\* master (syncd), # master (unsyncd), + selected, - candidate, ~ configured  
CHE #

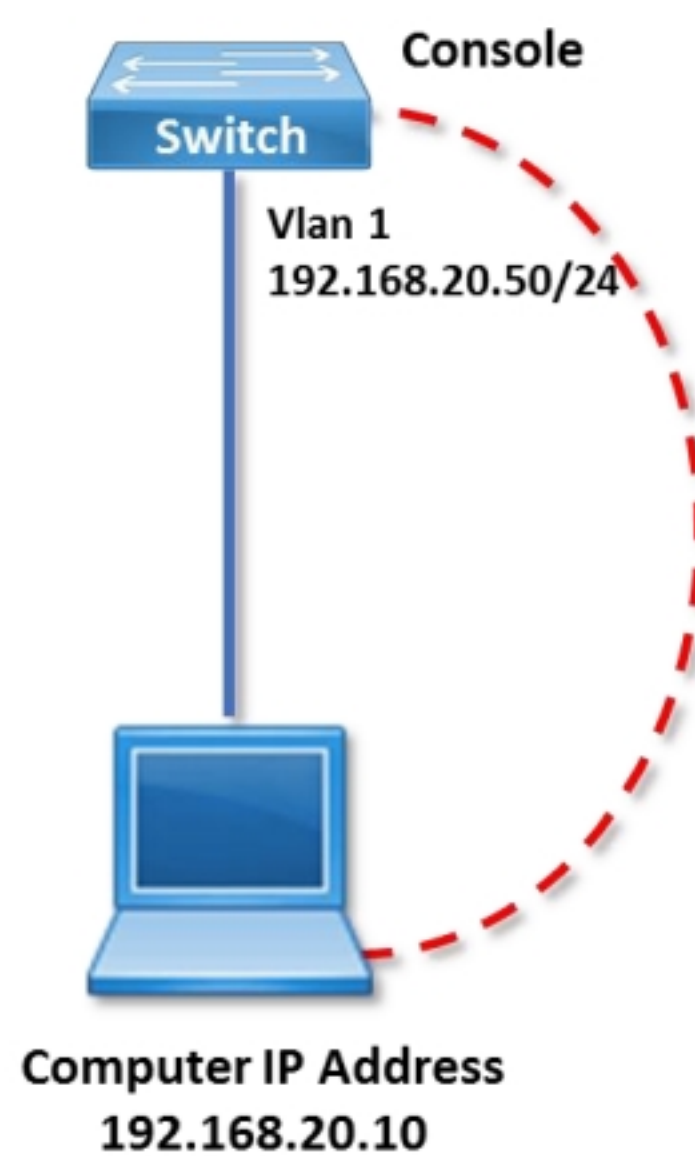
## LAB 19: INITIAL CONFIGURATION OF SWITCH

### OBJECTIVE:

To get familiar with Cisco Switch IOS modes and configure a New Switch with basic configuration i.e. assigning management IP address to the switch and configure passwords etc.

### TOPOLOGY:

Setup console and ethernet connectivity for the lab as below :



### TASK:

- Establish console connectivity
- Access switch via console with an emulation software
- Get familiar with Cisco Switch IOS Modes and Show commands
- Configure Hostname and VLAN 1 Interface IP address
- Configure Connectivity Passwords
- Configure Privilege Mode / Enable Password
- Save configuration on the switch
- Access the Switch via Telnet



### Establish console connectivity

Establish console connectivity by connecting switch console port to PC Com Port with console cable.

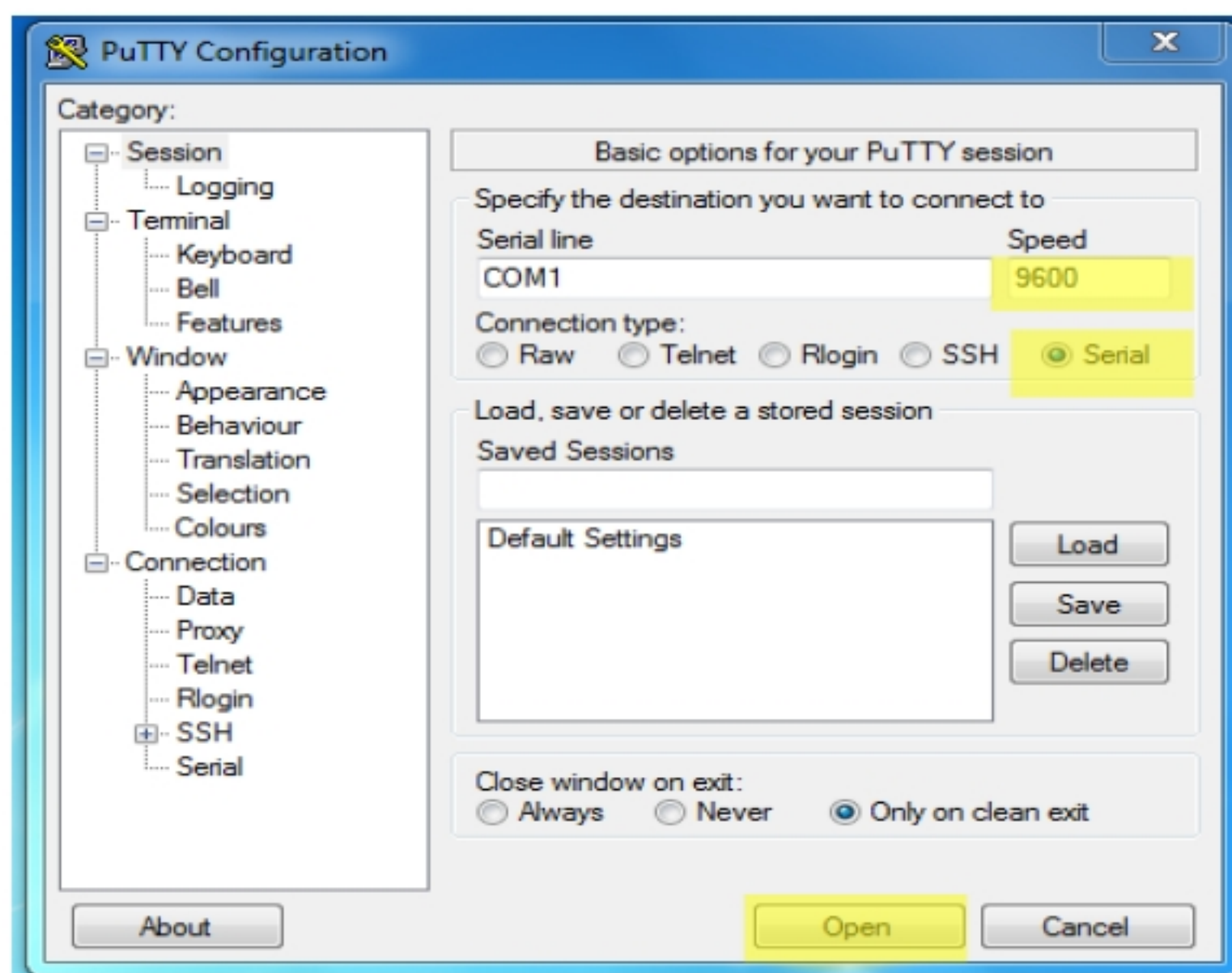
### Access switch via console with an emulation software

Configure the following parameters in emulation software for accessing switch via console port.

| Parameters | Console Port Settings |
|------------|-----------------------|
| Baud       | 9600                  |
| Data bits  | 8                     |
| Parity     | None                  |
| Stop bits  | 1                     |

### **Accessing switch via console from Microsoft Windows Computer**

- Start a terminal emulator application, such as **PUTTY.exe**
- Select **Serial** option and set speed to **9600**.
- Click **Open**



- Once emulation software is ready, **Power-ON** the switch.

### **Accessing switch via console from Linux Computer**

- From the terminal enter the below command  
**# minicom**
- Once emulation software is ready, **Power-ON** the Switch.

## Getting familiar with Cisco Switch IOS Modes and show commands

After the switch boots-up completely, (on a new Cisco Switch) it enters user mode as below:

```
Switch>
```

### To navigate into Privilege mode/Executive Mode from User Mode

```
Switch >enable
```

```
Switch #
```

### To view switch IOS and hardware information

```
Switch # show version
```

```
Cisco Internetwork Operating System Software
IOS (tm) C2950 Software (C2950-I6Q4L2-M), Version 12.1(22)EA6, RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2005 by cisco Systems, Inc.
Compiled Fri 21-Oct-05 01:59 by yenanh
Image text-base: 0x80010000, data-base: 0x80568000
```

```
ROM: Bootstrap program is C2950 boot loader
```

```
Switch uptime is 4 minutes
System returned to ROM by power-on
System image file is "flash:/c2950-i6q4l2-mz.121-22.EA6.bin"
```

```
cisco WS-C2950-24 (RC32300) processor (revision G0) with 21013K bytes of memory.
Processor board ID FOC0638Z0TB
Last reset from system-reset
Running Standard Image
24 FastEthernet/IEEE 802.3 interface(s)
```

```
32K bytes of flash-simulated non-volatile configuration memory.
Base ethernet MAC Address: 00:0A:F4:C5:94:C0
Motherboard assembly number: 73-5781-11
Power supply part number: 34-0965-01
Motherboard serial number: FOC06380AZK
Power supply serial number: DAB06347236
Model revision number: G0
Motherboard revision number: A0
Model number: WS-C2950-24
System serial number: FOC0638Z0TB
Configuration register is 0xF
```

```
Switch #
```



**To view switch flash Information**

Switch # **show flash**

Directory of flash:/

```
 1 -rwx   3110758 Mar 01 1993 08:30:59 +00:00 c2950-i6q4l2-mz.121-22.EA6.bin
 2 -rwx     564 Mar 01 1993 00:00:28 +00:00 vlan.dat
```

7741440 bytes total (4628480 bytes free)

Switch #

**To view switch current configuration (RAM)**

Switch # **show running-config**

Building configuration...

Current configuration : 1071 bytes

!

version 12.1

no service pad

service timestamps debug uptime

service timestamps log uptime

no service password-encryption

!

hostname Switch

!

spanning-tree mode pvst

no spanning-tree optimize bpdu transmission

spanning-tree extend system-id

!

interface FastEthernet0/1

!

interface FastEthernet0/2

!

<output omitted>

!

interface FastEthernet0/23

!

interface FastEthernet0/24

!

interface Vlan1

no ip address

no ip route-cache

shutdown

!

ip http server

!

line con 0

line vty 5 15

!

end

Switch #

## To view switch startup configuration (NVRAM)

Switch # **show startup-config**

startup-config is not present

## To view detailed interface information (i.e. Vlan, interface status, etc.)

Switch # **show interface status**

| Port   | Name | Status     | Vlan | Duplex | Speed | Type         |
|--------|------|------------|------|--------|-------|--------------|
| Fa0/1  |      | connected  | 1    | a-full | a-100 | 10/100BaseTX |
| Fa0/2  |      | connected  | 1    | a-full | a-100 | 10/100BaseTX |
| Fa0/3  |      | connected  | 1    | a-full | a-100 | 10/100BaseTX |
| Fa0/4  |      | connected  | 1    | a-full | a-100 | 10/100BaseTX |
| Fa0/5  |      | connected  | 1    | a-full | a-100 | 10/100BaseTX |
| Fa0/6  |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/7  |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/8  |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/9  |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/10 |      | connected  | 1    | a-half | a-10  | 10/100BaseTX |
| Fa0/11 |      | connected  | 1    | a-half | a-10  | 10/100BaseTX |
| Fa0/12 |      | connected  | 1    | a-half | a-10  | 10/100BaseTX |
| Fa0/13 |      | connected  | 1    | a-half | a-10  | 10/100BaseTX |
| Fa0/14 |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/15 |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/16 |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/17 |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/18 |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/19 |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/20 |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/21 |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/22 |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/23 |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/24 |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |

Switch #

## To view Mac Address Table

Switch # **show mac-address-table**

Mac Address Table

| Vlan | Mac Address    | Type    | Ports  |
|------|----------------|---------|--------|
| All  | 000a.f4c5.94c0 | STATIC  | CPU    |
| All  | 0100.0ccc.cccc | STATIC  | CPU    |
| All  | 0100.0ccc.cccd | STATIC  | CPU    |
| All  | 0100.0cdd.dddd | STATIC  | CPU    |
| 1    | 0002.4b60.d100 | DYNAMIC | Fa0/13 |
| 1    | 0002.fd73.7f20 | DYNAMIC | Fa0/11 |



|   |                |         |        |
|---|----------------|---------|--------|
| 1 | 0010.7bb3.6f20 | DYNAMIC | Fa0/12 |
| 1 | 001c.c012.4f54 | DYNAMIC | Fa0/4  |
| 1 | 0030.9476.f160 | DYNAMIC | Fa0/10 |

Total Mac Addresses for this criterion: 5

Switch #

### **Configure Hostname and VLAN 1 Interface IP address**

#### **To change the Host Name of Switch**

Switch # **configure terminal**

Switch (config) # **hostname SW1**

SW1 (config) #

#### **To configure IP address on Interface VLAN 1**

SW1 (config) # **interface vlan 1**

SW1 (config-if) # **ip address 192.168.20.50 255.255.255.0**

SW1 (config-if) # **no shutdown**

SW1 (config-if) #**exit**

### **Configure Connectivity Passwords**

#### **To configure telnet password**

SW1 (config) # **line vty 0 15**

SW1 (config-line) # **password zoom**

SW1 (config-line) #**login**

SW1 (config-line) #**exit**

#### **To configure console password**

SW1 (config) # **line console 0**

SW1 (config-line) # **password zoom**

SW1 (config-line) #**login**

SW1 (config-line) # **exit**

### **Configure Privilege Mode / Enable Password**

#### **Configure privilege password**

SW1 (config) #**enable password ccna**

SW1 (config) #**enable secret zoom**

## Configure Default Gateway and Description on Interface

SW1 (config) # **ip default-gateway 192.168.20.1**

SW1 (config) # **interface fastethernet 0/24**

SW1 (config-if) # **description Link to SW2**

SW1 (config-if) # **end**

## Save configuration on the switch

**To save configuration on switch**

SW1 # **copy running-config startup-config**

Destination filename [startup-config]?

Building configuration...

[OK]

SW1 #

**To view switch startup configuration (NVRAM)**

SW1 # **show startup-config**

Building configuration...

Current configuration : 1230 bytes

!

version 12.1

no service pad

service timestamps debug uptime

service timestamps log uptime

no service password-encryption

!

hostname SW1

!

enable secret 5 \$1\$HYD-1we\$Mk0jdo9UpDL1T7kqcKHhk1

enable password ccna

!

ip subnet-zero

!

spanning-tree mode pvst

no spanning-tree optimize bpdu transmission

spanning-tree extend system-id

!

interface FastEthernet0/1

!

interface FastEthernet0/2

!

!

<output omitted>



```
!  
interface FastEthernet0/23  
!  
interface FastEthernet0/24  
  description Link to SW2  
!  
interface Vlan1  
  ip address 192.168.20.50 255.255.255.0  
  no ip route-cache  
!  
ip default-gateway 192.168.20.1  
ip http server  
!  
line con 0  
  password zoom  
  login  
line vty 0 4  
  password zoom  
  login  
line vty 5 15  
  password zoom  
  login  
!  
!  
end
```

### Access the Switch via Telnet

- Access switch via telnet by giving the following command on a Windows or Linux computer.  
**telnet 192.168.20.50**

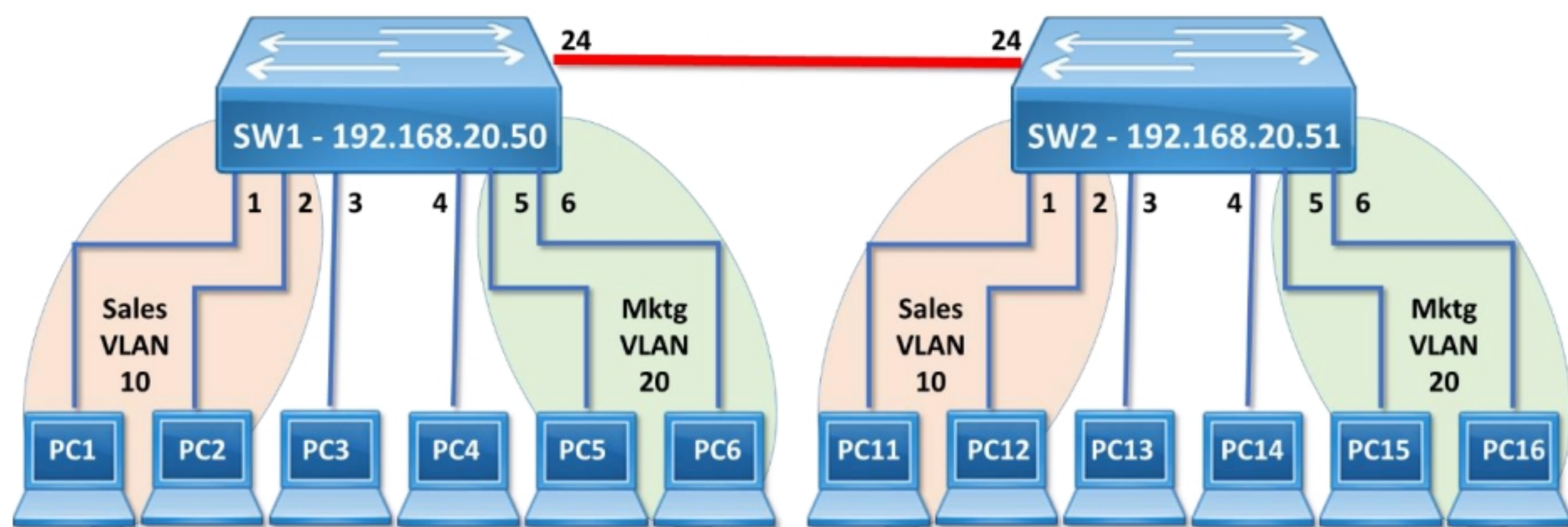
## LAB 20: VLAN AND TRUNKING

### OBJECTIVE:

To configure VLANs and trunking in a switched network.

### TOPOLOGY:

Setup Switch and Computer connectivity for the lab as below:



### TASK:

- Verify communication between the computers connected to same as well as a different switch.
- Verify Default VLAN information
- Configure and Implement VLANs
- Verify communication between the computers connected to same switch.
- Configure Trunking
- Verify communication between the computers connected to different switches.



## Verify communication between the computers connected to same and different switches

### From 192.168.20.1 computer (i.e. PC1) ping computers on the same switch

#### **ping 192.168.20.2**

PING 192.168.20.2 (192.168.20.2) 56(84) bytes of data.  
64 bytes from 192.168.20.2: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.2: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.2: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.20.2: icmp\_seq=4 ttl=62 time=24.0 ms

#### **ping 192.168.20.3**

PING 192.168.20.3 (192.168.20.3) 56(84) bytes of data.  
64 bytes from 192.168.20.3: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.3: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.3: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.20.3: icmp\_seq=4 ttl=62 time=24.0 ms

#### **ping 192.168.20.5**

PING 192.168.20.5 (192.168.20.5) 56(84) bytes of data.  
64 bytes from 192.168.20.5: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.5: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.5: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.20.5: icmp\_seq=4 ttl=62 time=24.0 ms

### From 192.168.20.1 computer (i.e. PC1) ping computers on the other switch

#### **ping 192.168.20.12**

PING 192.168.20.12 (192.168.20.12) 56(84) bytes of data.  
64 bytes from 192.168.20.12: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.12: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.12: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.20.12: icmp\_seq=4 ttl=62 time=24.0 ms

#### **ping 192.168.20.13**

PING 192.168.20.13 (192.168.20.13) 56(84) bytes of data.  
64 bytes from 192.168.20.13: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.13: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.13: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.20.13: icmp\_seq=4 ttl=62 time=24.0 ms

**ping 192.168.20.15**

```

PING 192.168.20.15 (192.168.20.15) 56(84) bytes of data.
64 bytes from 192.168.20.15: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.20.15: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.20.15: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.20.15: icmp_seq=4 ttl=62 time=24.0 ms

```

### **Verify Default VLAN information**

**To view existing VLAN and port assigned to VLAN**

#### **SW1 – Verification:**

**SW1 # show vlan brief**

| VLAN Name            | Status    | Ports   |
|----------------------|-----------|---|
| 1 default            | active    | Fa0/1, Fa0/2, Fa0/3, Fa0/4, Fa0/5, Fa0/6, Fa0/7, Fa0/8, Fa0/9, Fa0/10, Fa0/11, Fa0/12, Fa0/13, Fa0/14, Fa0/15, Fa0/16, Fa0/17, Fa0/18, Fa0/19, Fa0/20, Fa0/21, Fa0/22, Fa0/23, Fa0/24 |
| 1002 fddi-default    | act/unsup |   |
| 1003 trcrf-default   | act/unsup |   |
| 1004 fddinet-default | act/unsup |   |
| 1005 trbrf-default   | act/unsup |   |

SW1 #

#### **SW2 – Verification:**

**SW2 # show vlan brief**

| VLAN Name            | Status    | Ports   |
|----------------------|-----------|---|
| 1 default            | active    | Fa0/1, Fa0/2, Fa0/3, Fa0/4, Fa0/5, Fa0/6, Fa0/7, Fa0/8, Fa0/9, Fa0/10, Fa0/11, Fa0/12, Fa0/13, Fa0/14, Fa0/15, Fa0/16, Fa0/17, Fa0/18, Fa0/19, Fa0/20, Fa0/21, Fa0/22, Fa0/23, Fa0/24 |
| 1002 fddi-default    | act/unsup |   |
| 1003 trcrf-default   | act/unsup |   |
| 1004 fddinet-default | act/unsup |   |
| 1005 trbrf-default   | act/unsup |   |

SW2 #



## Configure and Implement VLAN

### SW1 – Configuration

SW1 #**configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW1 (config) # **vlan 10**

SW1 (config-vlan) # **name SALES**

SW1 (config-vlan) #**exit**

SW1 (config) # **vlan 20**

SW1 (config-vlan) # **name MKTG**

SW1 (config-vlan) #**exit**

SW1 (config) #

SW1 (config) # **interface range fastethernet 0/1 -2**

SW1 (config-if-range) # **switchport mode access**

SW1 (config-if-range) # **switchport access vlan 10**

SW1 (config-if-range) # **exit**

SW1(config) #

SW1 (config) # **interface range fastethernet 0/5 -6**

SW1 (config-if-range) # **switchport mode access**

SW1 (config-if-range) # **switchport access vlan 20**

SW1 (config-if-range) # **exit**

### SW2 – Configuration

SW2 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW2 (config) # **vlan 10**

SW2 (config-vlan) # **name SALES**

SW2 (config-vlan) #**exit**

SW2 (config) # **vlan 20**

SW2 (config-vlan) # **name MKTG**

SW2 (config-vlan) #**exit**

SW2 (config) #

SW2 (config) # **interface range fastethernet 0/1 -2**

SW2 (config-if-range) # **switchport mode access**

SW2 (config-if-range) # **switchport access vlan 10**

SW2 (config-if-range) # **exit**

SW2(config) #

SW2 (config) # **interface range fastethernet 0/5 -6**

SW2 (config-if-range) # **switchport mode access**

SW2 (config-if-range) # **switchport access vlan 20**

SW2 (config-if-range) # **exit**

To view existing VLAN and port assigned to VLAN

**SW1 – Verification:**

SW1 # show vlan brief

| VLAN Name            | Status    | Ports   |
|----------------------|-----------|---|
| 1 default            | active    | Fa0/3, Fa0/4, Fa0/7, Fa0/8, Fa0/9, Fa0/10, Fa0/11, Fa0/12, Fa0/13, Fa0/14, Fa0/15, Fa0/16, Fa0/17, Fa0/18, Fa0/19, Fa0/20, Fa0/21, Fa0/22, Fa0/23, Fa0/24 |
| 10 SALES             | active    | Fa0/1, Fa0/2  |
| 20 MKTG              | active    | Fa0/5, Fa0/6  |
| 1002 fddi-default    | act/unsup |   |
| 1003 trcrf-default   | act/unsup |   |
| 1004 fddinet-default | act/unsup |   |
| 1005 trbrf-default   | act/unsup |   |

SW1 #

SW1 # show interface fastethernet 0/1 switchport

Name: Fa0/1  
Switchport: Enabled  
Administrative Mode: static access  
Operational Mode: static access  
Administrative Trunking Encapsulation: dot1q  
Operational Trunking Encapsulation: native  
Negotiation of Trunking: Off  
Access Mode VLAN: 10 (SALES)  
Trunking Native Mode VLAN: 1 (default)  
Voice VLAN: none  
Administrative private-vlan host-association: none  
Administrative private-vlan mapping: none  
Administrative private-vlan trunk native VLAN: none  
Administrative private-vlan trunk encapsulation: dot1q  
Administrative private-vlan trunk normal VLANs: none  
Administrative private-vlan trunk private VLANs: none  
Operational private-vlan: none  
Trunking VLANs Enabled: ALL  
Pruning VLANs Enabled: 2-1001  
Capture Mode Disabled  
Capture VLANs Allowed: ALL  
Protected: false  
Appliance trust: none

SW1 #



## SW2 – Verification:

SW2 # show vlan brief

| VLAN Name            | Status    | Ports   |
|----------------------|-----------|---|
| 1 default            | active    | Fa0/3, Fa0/4, Fa0/7, Fa0/8, Fa0/9, Fa0/10, Fa0/11, Fa0/12, Fa0/13, Fa0/14, Fa0/15, Fa0/16, Fa0/17, Fa0/18, Fa0/19, Fa0/20, Fa0/21, Fa0/22, Fa0/23, Fa0/24 |
| 10 SALES             | active    | Fa0/1, Fa0/2  |
| 20 MKTG              | active    | Fa0/5, Fa0/6  |
| 1002 fddi-default    | act/unsup |   |
| 1003 trcrf-default   | act/unsup |   |
| 1004 fddinet-default | act/unsup |   |
| 1005 trbrf-default   | act/unsup |   |

SW2 #

SW2 # show interface fastethernet 0/1 switchport

Name: Fa0/5  
Switchport: Enabled  
Administrative Mode: static access  
Operational Mode: static access  
Administrative Trunking Encapsulation: dot1q  
Operational Trunking Encapsulation: native  
Negotiation of Trunking: Off  
Access Mode VLAN: 20 (MKTG)  
Trunking Native Mode VLAN: 1 (default)  
Voice VLAN: none  
Administrative private-vlan host-association: none  
Administrative private-vlan mapping: none  
Administrative private-vlan trunk native VLAN: none  
Administrative private-vlan trunk encapsulation: dot1q  
Administrative private-vlan trunk normal VLANs: none  
Administrative private-vlan trunk private VLANs: none  
Operational private-vlan: none  
Trunking VLANs Enabled: ALL  
Pruning VLANs Enabled: 2-1001  
Capture Mode Disabled  
Capture VLANs Allowed: ALL  
Protected: false  
Appliance trust: none

SW2 #

**Verify communication between the computers connected to same switch.**

**From 192.168.20.1 computer (i.e. PC1)**

**ping 192.168.20.2**

PING 192.168.20.2 (192.168.20.2) 56(84) bytes of data.  
64 bytes from 192.168.20.2: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.2: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.2: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.20.2: icmp\_seq=4 ttl=62 time=24.0 ms

**ping 192.168.20.3**

PING 192.168.20.3 (192.168.20.3) 56(84) bytes of data.  
From 192.168.20.1 icmp\_seq=1 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=2 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=3 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=3 Destination Host Unreachable

**ping 192.168.20.5**

PING 192.168.20.5 (192.168.20.5) 56(84) bytes of data.  
From 192.168.20.1 icmp\_seq=1 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=2 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=3 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=3 Destination Host Unreachable

**From 192.168.20.6 computer (i.e. PC6)**

**ping 192.168.20.2**

PING 192.168.20.2 (192.168.20.2) 56(84) bytes of data.  
From 192.168.20.6 icmp\_seq=1 Destination Host Unreachable  
From 192.168.20.6 icmp\_seq=2 Destination Host Unreachable  
From 192.168.20.6 icmp\_seq=3 Destination Host Unreachable  
From 192.168.20.6 icmp\_seq=3 Destination Host Unreachable

**ping 192.168.20.5**

PING 192.168.20.5 (192.168.20.5) 56(84) bytes of data.  
64 bytes from 192.168.20.5: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.5: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.5: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.20.5: icmp\_seq=4 ttl=62 time=24.0 ms



## Configure Trunking

### SW1 – Configuration

SW1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW1 (config)# **interface fastethernet 0/24**

SW1 (config-if)# **switchport mode trunk**

SW1 (config-if)# **switchport trunk allowed vlan all**

SW1 (config-if)# **^Z**

SW1 #

### SW2 – Configuration

SW2 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW2 (config)# **interface fastethernet 0/24**

SW2 (config-if)# **switchport mode trunk**

SW2 (config-if)# **switchport trunk allowed vlan all**

SW2 (config-if)# **^Z**

SW2 #

## Verify trunk configuration

### SW1 – Verification:

SW1 # **show interface trunk**

| Port   | Mode | Encapsulation | Status   | Native vlan |
|--------|------|---------------|----------|-------------|
| Fa0/24 | on   | 802.1q        | trunking | 1           |

| Port   | Vlans allowed on trunk |
|--------|------------------------|
| Fa0/24 | 1-4094                 |

| Port   | Vlans allowed and active in management domain |
|--------|---|
| Fa0/24 | 1,10,20                                       |

| Port   | Vlans in spanning tree forwarding state and not pruned |
|--------|--|
| Fa0/24 | none   |

SW1 #

SW1 # show interface fastethernet 0/24 switchport

Name: Fa0/24

Switchport: Enabled

Administrative Mode: trunk

Operational Mode: trunk

Administrative Trunking Encapsulation: dot1q

Operational Trunking Encapsulation: dot1q

Negotiation of Trunking: On

Access Mode VLAN: 1 (default)

Trunking Native Mode VLAN: 1 (default)

Voice VLAN: none

Administrative private-vlan host-association: none

Administrative private-vlan mapping: none

Administrative private-vlan trunk native VLAN: none

Administrative private-vlan trunk encapsulation: dot1q

Administrative private-vlan trunk normal VLANs: none

Administrative private-vlan trunk private VLANs: none

Operational private-vlan: none

Trunking VLANs Enabled: ALL

Pruning VLANs Enabled: 2-1001

Capture Mode Disabled

Capture VLANs Allowed: ALL

Protected: false

Appliance trust: none

SW1 #

## SW2 – Verification:

SW2 # show interface trunk

| Port   | Mode | Encapsulation | Status   | Native vlan |
|--------|------|---------------|----------|-------------|
| Fa0/24 | on   | 802.1q        | trunking | 1           |

| Port   | Vlans allowed on trunk |
|--------|------------------------|
| Fa0/24 | 1-4094                 |

| Port   | Vlans allowed and active in management domain |
|--------|---|
| Fa0/24 | 1,10,20                                       |

| Port   | Vlans in spanning tree forwarding state and not pruned |
|--------|--|
| Fa0/24 | none   |

SW2 #



**SW2 # show interface fastethernet 0/24 switchport**

Name: Fa0/24

Switchport: Enabled

Administrative Mode: trunk

Operational Mode: trunk

Administrative Trunking Encapsulation: dot1q

Operational Trunking Encapsulation: dot1q

Negotiation of Trunking: On

Access Mode VLAN: 1 (default)

Trunking Native Mode VLAN: 1 (default)

Voice VLAN: none

Administrative private-vlan host-association: none

Administrative private-vlan mapping: none

Administrative private-vlan trunk native VLAN: none

Administrative private-vlan trunk encapsulation: dot1q

Administrative private-vlan trunk normal VLANs: none

Administrative private-vlan trunk private VLANs: none

Operational private-vlan: none

Trunking VLANs Enabled: ALL

Pruning VLANs Enabled: 2-1001

Capture Mode Disabled

Capture VLANs Allowed: ALL

Protected: false

Appliance trust: none

SW2 #

**Verify communication between the computers connected to different switch.****From 192.168.20.1 computer (i.e. PC1)****ping 192.168.20.12**

PING 192.168.20.12 (192.168.20.12) 56(84) bytes of data.  
64 bytes from 192.168.20.12: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.12: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.12: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.20.12: icmp\_seq=4 ttl=62 time=24.0 ms

**ping 192.168.20.13**

PING 192.168.20.13 (192.168.20.13) 56(84) bytes of data.  
From 192.168.20.1 icmp\_seq=1 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=2 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=3 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=3 Destination Host Unreachable

**ping 192.168.20.15**

PING 192.168.20.15 (192.168.20.15) 56(84) bytes of data.  
From 192.168.20.1 icmp\_seq=1 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=2 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=3 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=3 Destination Host Unreachable



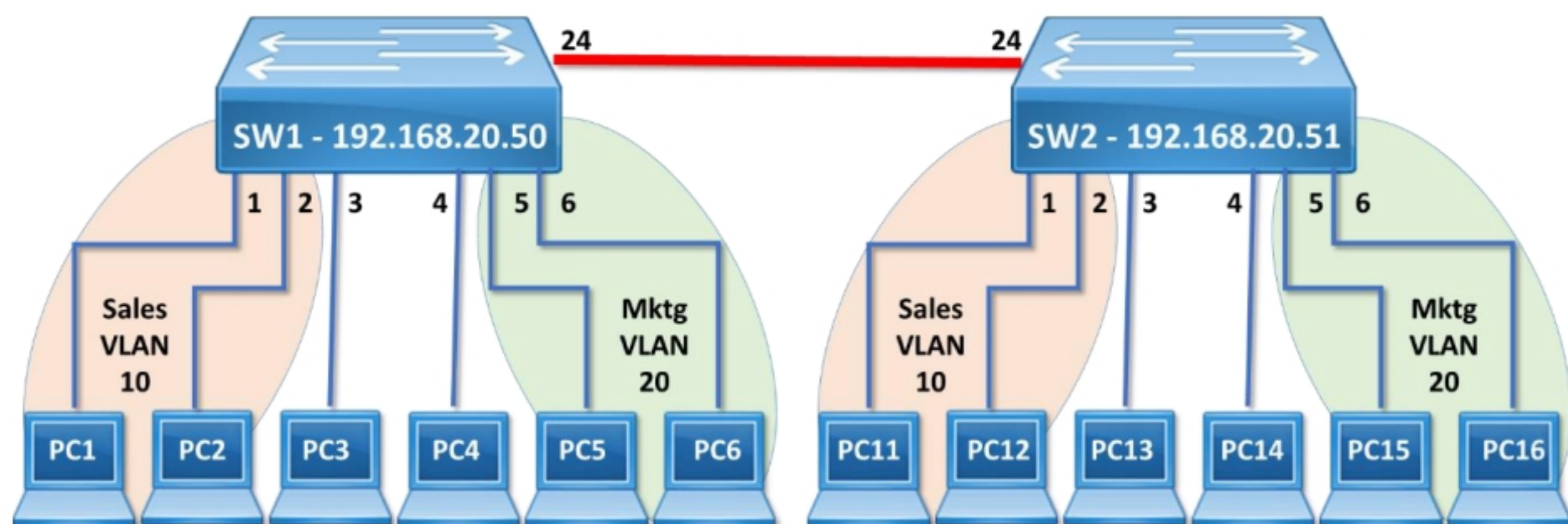
## LAB 21: DYNAMIC TRUNKING PROTOCOL (DTP)

### OBJECTIVE:

To configure Dynamic trunking protocol in a switched network.

### TOPOLOGY:

Setup Switch and Computer connectivity for the lab as below:



**Pre-requisite:** VLAN and Trunking configuration to be done on the Switch (LAB – 20)

### TASK:

- Configure Dynamic Trunking Protocol (DTP)
- Verify communication between the computers connected to different switches.

## Configure DTP Trunking

### SW1 – Configuration

SW1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW1 (config)# **interface fastethernet 0/24**

SW1 (config-if)# **switchport mode dynamic desirable**

SW1 (config-if)# **end**

SW1 #

### SW2 – Configuration

SW2 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW2 (config)# **interface fastethernet 0/24**

SW2 (config-if)# **switchport mode dynamic auto**

SW2 (config-if)# **end**

SW2 #

## Verify DTP Trunk configuration

### SW1 – Verification:

SW1 # **show interface trunk**

| Port   | Mode      | Encapsulation | Status   | Native vlan |
|--------|-----------|---------------|----------|-------------|
| Fa0/24 | desirable | 802.1q        | trunking | 1           |

| Port   | Vlans allowed on trunk |
|--------|------------------------|
| Fa0/24 | 1-4094                 |

| Port   | Vlans allowed and active in management domain |
|--------|---|
| Fa0/24 | 1,10,20                                       |

| Port   | Vlans in spanning tree forwarding state and not pruned |
|--------|--|
| Fa0/24 | none   |

SW1 #



SW1 # show interface fastethernet 0/24 switchport

Name: Fa0/24

Switchport: Enabled

Administrative Mode: dynamic desirable

Operational Mode: trunk

Administrative Trunking Encapsulation: dot1q

Operational Trunking Encapsulation: dot1q

Negotiation of Trunking: On

Access Mode VLAN: 1 (default)

Trunking Native Mode VLAN: 1 (default)

Voice VLAN: none

Administrative private-vlan host-association: none

Administrative private-vlan mapping: none

Administrative private-vlan trunk native VLAN: none

Administrative private-vlan trunk encapsulation: dot1q

Administrative private-vlan trunk normal VLANs: none

Administrative private-vlan trunk private VLANs: none

Operational private-vlan: none

Trunking VLANs Enabled: ALL

Pruning VLANs Enabled: 2-1001

Capture Mode Disabled

Capture VLANs Allowed: ALL

Protected: false

Appliance trust: none

SW1 #

### SW2 – Verification:

SW2 # show interface trunk

| Port   | Mode | Encapsulation | Status   | Native vlan |
|--------|------|---------------|----------|-------------|
| Fa0/24 | Auto | 802.1q        | trunking | 1           |

| Port   | Vlans allowed on trunk |
|--------|------------------------|
| Fa0/24 | 1-4094                 |

| Port   | Vlans allowed and active in management domain |
|--------|---|
| Fa0/24 | 1,10,20                                       |

| Port   | Vlans in spanning tree forwarding state and not pruned |
|--------|--|
| Fa0/24 | none   |

SW2 #

**SW2 # show interface fastethernet 0/24 switchport**

Name: Fa0/24

Switchport: Enabled

Administrative Mode: dynamic auto

Operational Mode: trunk

Administrative Trunking Encapsulation: dot1q

Operational Trunking Encapsulation: dot1q

Negotiation of Trunking: On

Access Mode VLAN: 1 (default)

Trunking Native Mode VLAN: 1 (default)

Voice VLAN: none

Administrative private-vlan host-association: none

Administrative private-vlan mapping: none

Administrative private-vlan trunk native VLAN: none

Administrative private-vlan trunk encapsulation: dot1q

Administrative private-vlan trunk normal VLANs: none

Administrative private-vlan trunk private VLANs: none

Operational private-vlan: none

Trunking VLANs Enabled: ALL

Pruning VLANs Enabled: 2-1001

Capture Mode Disabled

Capture VLANs Allowed: ALL

Protected: false

Appliance trust: none

SW2 #



**Verify communication between the computers connected to different switch.****From 192.168.20.1 computer (i.e. PC1)****ping 192.168.20.12**

PING 192.168.20.12 (192.168.20.12) 56(84) bytes of data.  
64 bytes from 192.168.20.12: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.12: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.20.12: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.20.12: icmp\_seq=4 ttl=62 time=24.0 ms

**ping 192.168.20.13**

PING 192.168.20.13 (192.168.20.13) 56(84) bytes of data.  
From 192.168.20.1 icmp\_seq=1 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=2 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=3 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=3 Destination Host Unreachable

**ping 192.168.20.15**

PING 192.168.20.15 (192.168.20.15) 56(84) bytes of data.  
From 192.168.20.1 icmp\_seq=1 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=2 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=3 Destination Host Unreachable  
From 192.168.20.1 icmp\_seq=3 Destination Host Unreachable

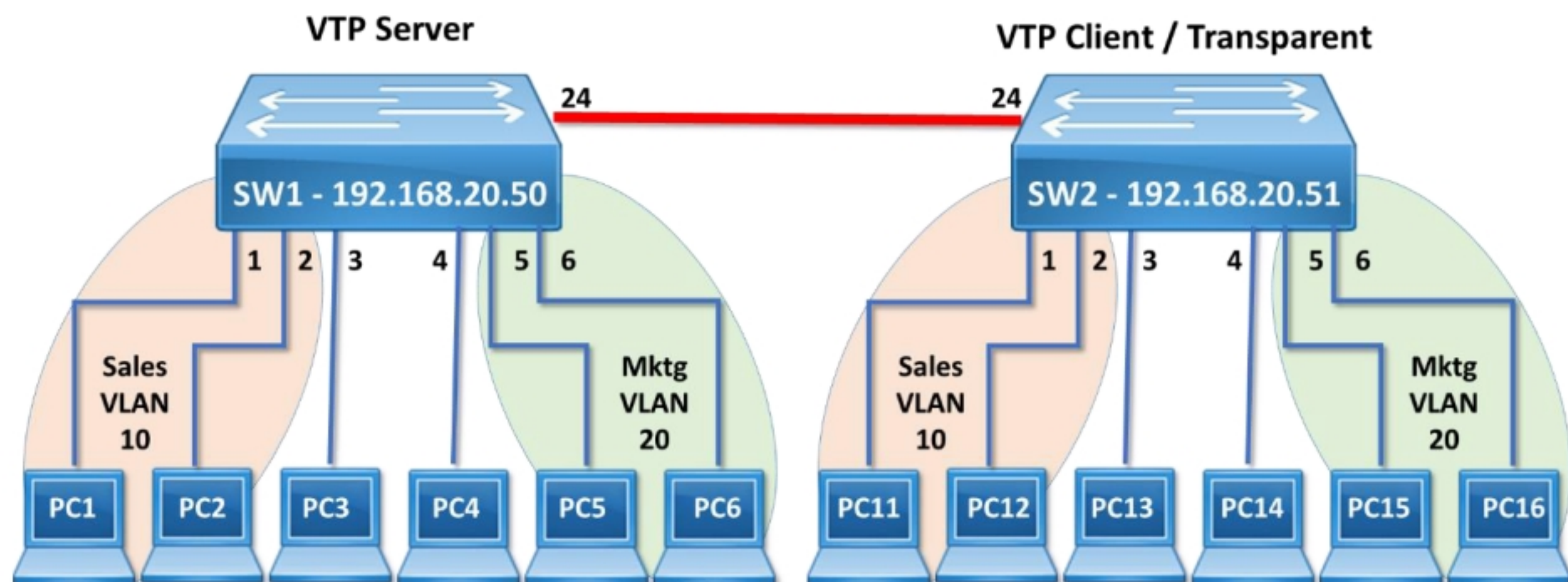
## LAB 22: VLAN TRUNKING PROTOCOL (VTP)

### OBJECTIVE:

To implement VTP domain name and password on switches across the network.

### TOPOLOGY:

Setup Switch connectivity for the lab as below :



**Pre-requisite: VLAN and Trunking configuration to be done on the Switch (LAB – 20)**

### TASK:

- Configure VTP domain name and password
- Verify the working of VTP



## Configure VTP Domain Name and Password

### SW1 – VTP Server Configuration

#### SW1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW1 (config) # **vtp domain ZOOM**

Changing VTP domain name from null to ZOOM

SW1 (config) # **vtp password CCNA**

Setting device VLAN database password to CCNA

SW1 (config) # ^Z

SW1 #

### SW2 – VTP Client Configuration

#### SW2 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW2 (config) # **vtp domain ZOOM**

Changing VTP domain name from null to ZOOM

SW2 (config) # **vtp password CCNA**

Setting device VLAN database password to CCNA

SW2 (config) # **vtp mode client**

Setting device to VTP CLIENT mode.

SW2 (config) # ^Z

SW2 #

### SW1 – Verification:

#### SW1 # **show vtp status**

```
VTP Version : 2
Configuration Revision : 0
Maximum VLANs supported locally : 64
Number of existing VLANs : 5
VTP Operating Mode : Server
VTP Domain Name : ZOOM
VTP Pruning Mode : Disabled
VTP V2 Mode : Disabled
VTP Traps Generation : Disabled
MD5 digest : 0x4C 0x9A 0xF5 0x6A 0x05 0xBA 0x83 0xE3
Configuration last modified by 192.168.20.50 at 3-1-93 02:26:12
SW1#
```

#### SW1 # **show vtp password**

VTP Password: CCNA

SW1#

**SW2 – Verification:****SW2 # show vtp status**

```
VTP Version : 2
Configuration Revision : 0
Maximum VLANs supported locally : 64
Number of existing VLANs : 5
VTP Operating Mode : Client
VTP Domain Name : ZOOM
VTP Pruning Mode : Disabled
VTP V2 Mode : Disabled
VTP Traps Generation : Disabled
MD5 digest : 0x4C 0x9A 0xF5 0x6A 0x05 0xBA 0x83 0xE3
Configuration last modified by 192.168.20.50 at 3-1-93 02:26:12
Local updater ID is 192.168.20.50 on interface Vl1 (lowest numbered VLAN interface found)
SW1#
```

**SW2 # show vtp password**

```
VTP Password: CCNA
SW2#
```

**Verify the working of VTP**

Create VLANs on Server Switch i.e. **SW1** and verify that these VLANs are automatically available on Client Switch i.e. **SW2**.

**SW1 – Configuration****SW1 # configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

**SW1 (config) # vlan 10****SW1 (config-vlan) # name SALES****SW1 (config-vlan) #exit****SW1 (config) # vlan 20****SW1 (config-vlan) # name MKTG****SW1 (config-vlan) #exit****SW1 (config) #**



### SW1 – Verification:

SW1 # show vlan brief

| VLAN Name            | Status    | Ports   |
|----------------------|-----------|---|
| 1 default            | active    | Fa0/3, Fa0/4, Fa0/7, Fa0/8, Fa0/9, Fa0/10, Fa0/11, Fa0/12, Fa0/13, Fa0/14, Fa0/15, Fa0/16, Fa0/17, Fa0/18, Fa0/19, Fa0/20, Fa0/21, Fa0/22, Fa0/23, Fa0/24 |
| 10 SALES             | active    |   |
| 20 MKTG              | active    |   |
| 1002 fddi-default    | act/unsup |   |
| 1003 trcrf-default   | act/unsup |   |
| 1004 fddinet-default | act/unsup |   |
| 1005 trbrf-default   | act/unsup |   |

SW1 #

### SW2 – Verification:

SW2 # show vlan brief

| VLAN Name            | Status    | Ports   |
|----------------------|-----------|---|
| 1 default            | active    | Fa0/3, Fa0/4, Fa0/7, Fa0/8, Fa0/9, Fa0/10, Fa0/11, Fa0/12, Fa0/13, Fa0/14, Fa0/15, Fa0/16, Fa0/17, Fa0/18, Fa0/19, Fa0/20, Fa0/21, Fa0/22, Fa0/23, Fa0/24 |
| 10 SALES             | active    |   |
| 20 MKTG              | active    |   |
| 1002 fddi-default    | act/unsup |   |
| 1003 trcrf-default   | act/unsup |   |
| 1004 fddinet-default | act/unsup |   |
| 1005 trbrf-default   | act/unsup |   |

SW2 #

Try to create VLANs on Client Switch i.e. SW2

### SW2 – Verification:

SW2 (config) # vlan 100

VTP VLAN configuration not allowed when device is in CLIENT mode.

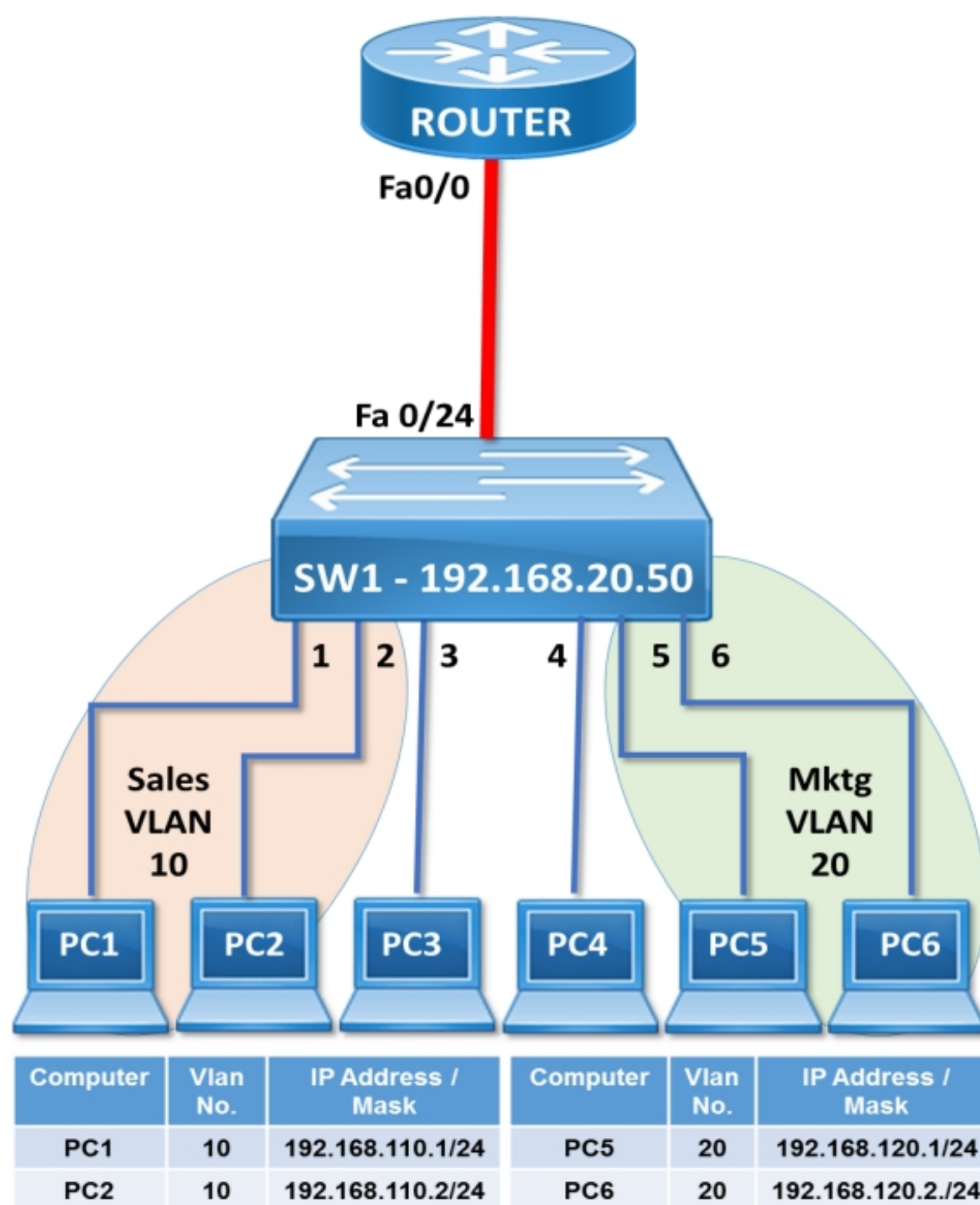
## LAB 23: ROUTER ON A STICK (INTER-VLAN ROUTING)

### OBJECTIVE:

To configure inter-vlan routing for communication between VLANs, by configuring sub interfaces on a router.

### TOPOLOGY:

Setup connectivity for the lab as below :



**Pre-requisite:** VLAN configuration to be done on the switch (LAB – 20)

### TASK:

- Verify communication between the computers in Different VLAN
- Configure Sub Interfaces and IP Routing on Router
- Verify communication between the computers in Different VLAN



## Verify communication between the computers in Different VLAN

### From 192.168.110.1 computer (i.e. PC1)

#### **ping 192.168.110.2**

PING 192.168.110.2 (192.168.110.2) 56(84) bytes of data.  
64 bytes from 192.168.110.2: icmp\_seq=1 ttl=64 time=24.0 ms  
64 bytes from 192.168.110.2: icmp\_seq=2 ttl=64 time=24.0 ms  
64 bytes from 192.168.110.2: icmp\_seq=3 ttl=64 time=24.1 ms  
64 bytes from 192.168.110.2: icmp\_seq=4 ttl=64 time=24.0 ms

#### **ping 192.168.120.2**

PING 192.168.120.2 (192.168.120.2) 56(84) bytes of data.  
From 192.168.120.2 icmp\_seq=1 Destination Host Unreachable  
From 192.168.120.2 icmp\_seq=2 Destination Host Unreachable  
From 192.168.120.2 icmp\_seq=3 Destination Host Unreachable  
From 192.168.120.2 icmp\_seq=3 Destination Host Unreachable

### From 192.168.120.1 computer (i.e. PC5)

#### **ping 192.168.110.2**

PING 192.168.110.2 (192.168.110.2) 56(84) bytes of data.  
From 192.168.110.2 icmp\_seq=1 Destination Host Unreachable  
From 192.168.110.2 icmp\_seq=2 Destination Host Unreachable  
From 192.168.110.2 icmp\_seq=3 Destination Host Unreachable  
From 192.168.110.2 icmp\_seq=3 Destination Host Unreachable

#### **ping 192.168.120.2**

PING 192.168.120.2 (192.168.120.2) 56(84) bytes of data.  
64 bytes from 192.168.120.2: icmp\_seq=1 ttl=64 time=24.0 ms  
64 bytes from 192.168.120.2: icmp\_seq=2 ttl=64 time=24.0 ms  
64 bytes from 192.168.120.2: icmp\_seq=3 ttl=64 time=24.1 ms  
64 bytes from 192.168.120.2: icmp\_seq=4 ttl=64 time=24.0 ms

## Configure Sub Interfaces and IP Routing on Router

### ROUTER – Configuration

```
ROUTER (config) # interface FastEthernet 0/0
ROUTER (config-if) # no shutdown
ROUTER (config-if) # exit
ROUTER (config) # interface FastEthernet 0/0.1
ROUTER (config-subif) # encapsulation dot1q 10
ROUTER (config-subif) # ip address 192.168.110.254 255.255.255.0
ROUTER (config-subif) # exit
ROUTER (config) # interface FastEthernet 0/0.2
ROUTER (config-subif) # encapsulation dot1q 20
ROUTER (config-subif) # ip address 192.168.120.254 255.255.255.0
ROUTER (config-subif) # exit
ROUTER (config) # ip routing
ROUTER (config) #
```

### ROUTER – Verification

```
ROUTER # show ip route
```

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, \* - candidate default, U - per-user static route  
o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP  
+ - replicated route, % - next hop override

Gateway of last resort is not set

```
192.168.110.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.110.0/24 is directly connected, FastEthernet0/0.1
L    192.168.110.254/32 is directly connected, GigabitEthernet0/0.1
192.168.120.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.120.0/24 is directly connected, FastEthernet0/0.2
L    192.168.120.254/32 is directly connected, GigabitEthernet0/0.2
Router #
```



## Verify communication between the computers in Different VLAN

### From 192.168.110.1 computer (i.e. PC1)

#### **ping 192.168.110.2**

PING 192.168.110.2 (192.168.110.2) 56(84) bytes of data.  
64 bytes from 192.168.110.2: icmp\_seq=1 ttl=64 time=24.0 ms  
64 bytes from 192.168.110.2: icmp\_seq=2 ttl=64 time=24.0 ms  
64 bytes from 192.168.110.2: icmp\_seq=3 ttl=64 time=24.1 ms  
64 bytes from 192.168.110.2: icmp\_seq=4 ttl=64 time=24.0 ms

#### **ping 192.168.120.2**

PING 192.168.120.2 (192.168.120.2) 56(84) bytes of data.  
64 bytes from 192.168.120.2: icmp\_seq=1 ttl=63 time=24.0 ms  
64 bytes from 192.168.120.2: icmp\_seq=2 ttl=63 time=24.0 ms  
64 bytes from 192.168.120.2: icmp\_seq=3 ttl=63 time=24.1 ms  
64 bytes from 192.168.120.2: icmp\_seq=4 ttl=63 time=24.0 ms

### From 192.168.120.1 computer (i.e. PC5)

#### **ping 192.168.110.2**

PING 192.168.110.2 (192.168.110.2) 56(84) bytes of data.  
64 bytes from 192.168.110.2: icmp\_seq=1 ttl=63 time=24.0 ms  
64 bytes from 192.168.110.2: icmp\_seq=2 ttl=63 time=24.0 ms  
64 bytes from 192.168.110.2: icmp\_seq=3 ttl=63 time=24.1 ms  
64 bytes from 192.168.110.2: icmp\_seq=4 ttl=63 time=24.0 ms

#### **ping 192.168.120.2**

PING 192.168.120.2 (192.168.120.2) 56(84) bytes of data.  
64 bytes from 192.168.120.2: icmp\_seq=1 ttl=64 time=24.0 ms  
64 bytes from 192.168.120.2: icmp\_seq=2 ttl=64 time=24.0 ms  
64 bytes from 192.168.120.2: icmp\_seq=3 ttl=64 time=24.1 ms  
64 bytes from 192.168.120.2: icmp\_seq=4 ttl=64 time=24.0 ms

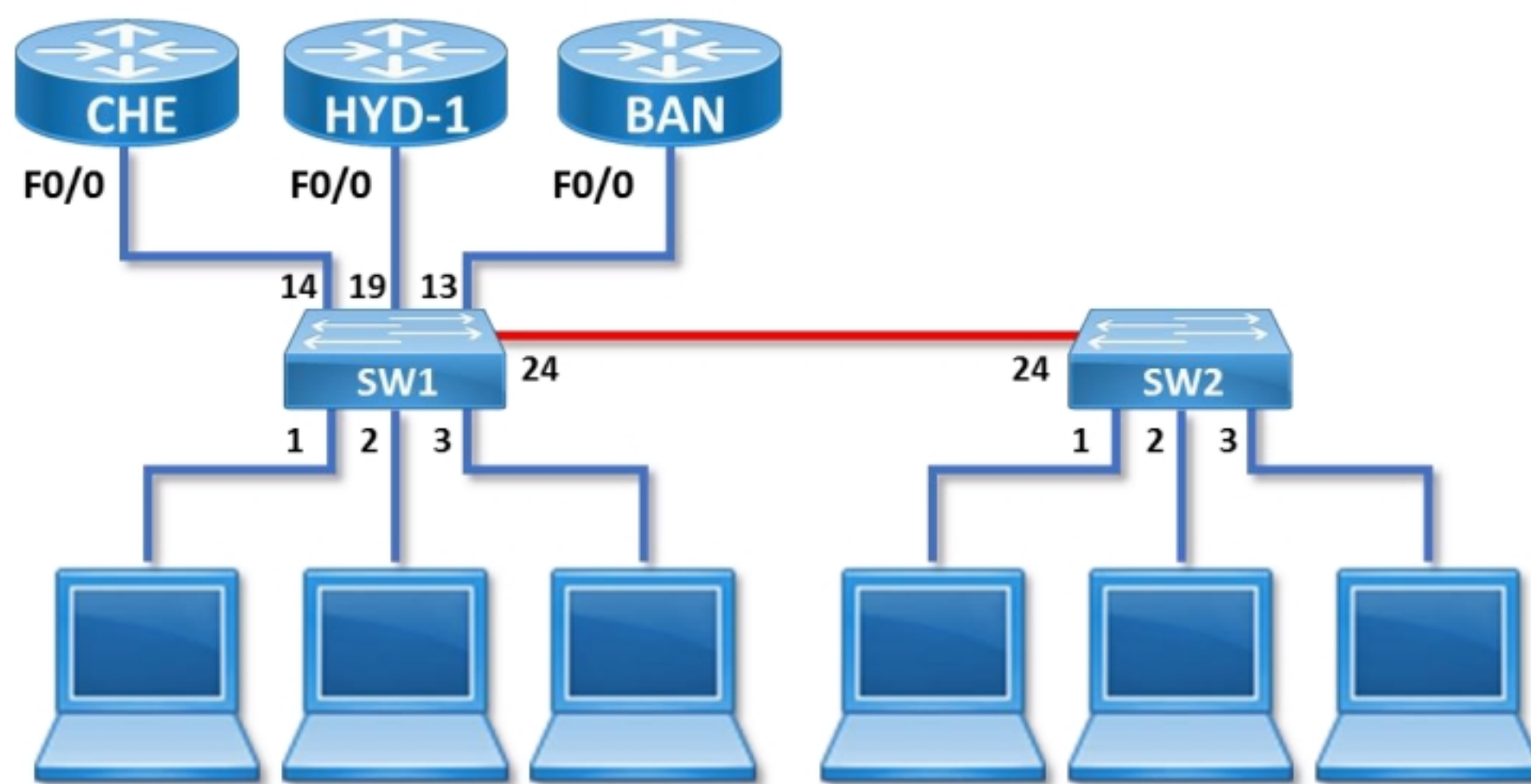
## LAB 24: CISCO DISCOVERY PROTOCOL (CDP)

### OBJECTIVE:

To enable CDP on routers and switches across the network for layer 2 troubleshooting.

### TOPOLOGY:

Setup Switch connectivity for the lab as below:



### TASK:

- Enable CDP
- Verify CDP information



## Enabling CDP

SW1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW1(config)# **cdp run**

SW1 #

## Verify CDP information

### SW1 – Verification:

SW1 # **show cdp neighbor**

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge  
S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone

| Device ID | Local Intrfce | Holdtme  | Capability | Platform   | Port ID            |
|-----------|---------------|----------|------------|------------|--------------------|
| SW2       | Fas 0/24      | 127      | S I        | WS-C2950-2 | Fas 0/24           |
| HYD-1     |               | Fas 0/19 | 145        | R S I      | Cisco 2821 Gig 0/0 |
| BAN       |               | Fas 0/13 | 124        | R S I      | Cisco 2611 Fas 0/0 |
| CHE       |               | Fas 0/14 | 142        | R          | 2610 Eth 0/0       |

SW1 #

SW1 # **show cdp neighbor detail**

-----  
Device ID: SW2

Entry address(es):

IP address: 192.168.20.51

Platform: cisco WS-C2950-24, Capabilities: Switch IGMP

Interface: FastEthernet0/24, Port ID (outgoing port): FastEthernet0/24

Holdtime : 167 sec

Version :

Cisco Internetwork Operating System Software

IOS (tm) C2950 Software (C2950-I6Q4L2-M), Version 12.1(13)EA1, RELEASE SOFTWARE (fc1)

Copyright (c) 1986-2003 by cisco Systems, Inc.

Compiled Tue 04-Mar-03 02:14 by yenanh

advertisement version: 2

Protocol Hello: OUI=0x00000C, Protocol ID=0x0112; payload len=27,  
value=00000000FFFFFFFFF010221FF0000000000000000D28F06840FF0000

VTP Management Domain: 'zoom'

Duplex: full

Management address(es):

-----  
Device ID: HYD-1

Entry address(es):

IP address: 192.168.202.1

Platform: Cisco 2821, Capabilities: Router Switch IGMP

Interface: FastEthernet0/19, Port ID (outgoing port): GigabitEthernet0/0

Holdtime : 126 sec

Version :

Cisco IOS Software, 2800 Software (C2800NM-ADVENTERPRISEK9-M), Version 15.1(3)T2, RELEASE SOFTWARE (fc1)

Technical Support: <http://www.cisco.com/techsupport>

Copyright (c) 1986-2011 by Cisco Systems, Inc.

Compiled Wed 10-Aug-11 05:17 by prod\_rel\_team

advertisement version: 2

VTP Management Domain: "

Duplex: full

Management address(es):

---

Device ID: BAN

Entry address(es):

IP address: 192.168.203.1

Platform: Cisco 2611XM, Capabilities: Router Switch IGMP

Interface: FastEthernet0/13, Port ID (outgoing port): FastEthernet0/0

Holdtime : 165 sec

Version :

Cisco IOS Software, C2600 Software (C2600-ADVENTERPRISEK9-M), Version 12.4(19), RELEASE SOFTWARE (fc1)

Technical Support: <http://www.cisco.com/techsupport>

Copyright (c) 1986-2008 by Cisco Systems, Inc.

Compiled Fri 29-Feb-08 19:23 by prod\_rel\_team

advertisement version: 2

VTP Management Domain: "

Duplex: full

Management address(es):

---

Device ID: CHE

Entry address(es):

IP address: 192.168.201.1

Platform: cisco 2610, Capabilities: Router

Interface: FastEthernet0/14, Port ID (outgoing port): Ethernet0/0

Holdtime : 122 sec

Version :

Cisco Internetwork Operating System Software

IOS (tm) C2600 Software (C2600-IS-M), Version 12.1(4), RELEASE SOFTWARE (fc1)

Copyright (c) 1986-2000 by cisco Systems, Inc.

Compiled Wed 30-Aug-00 14:11 by cmong

advertisement version: 2

Duplex: half

Management address(es):



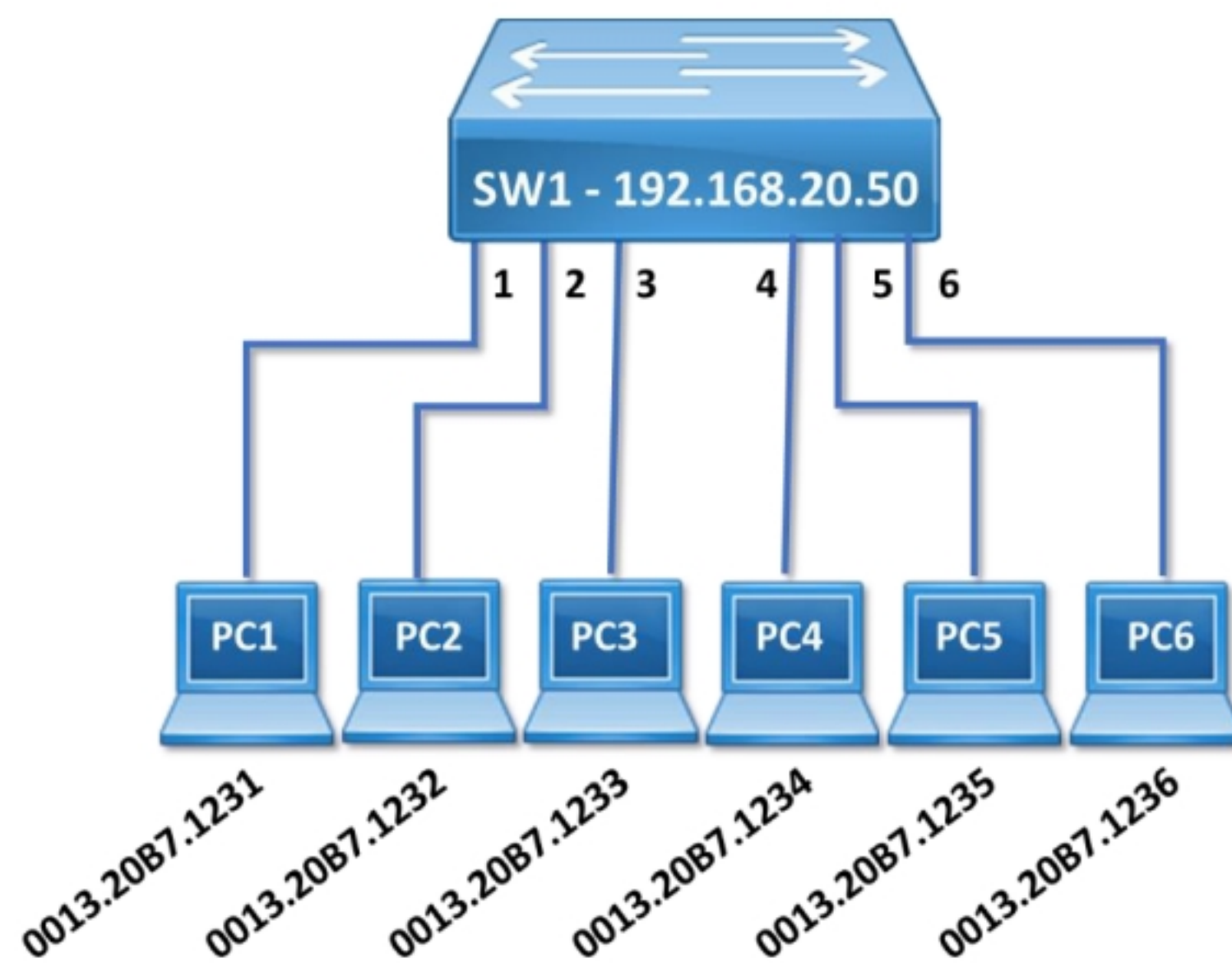
## LAB 25: PORT SECURITY

### OBJECTIVE:

To implement Port Security on switches across the network.

### TOPOLOGY:

Setup Switch connectivity for the lab as below :



### TASK:

- Configure Port Security
- Verify Port Security violation
- Configure Port Security Recovery

## Configure Port Security

```
SW1 (config)# interface fastethernet 0/2
SW1 (config-if)# switchport mode access
SW1 (config-if)# switchport port-security maximum 1
SW1 (config-if)# switchport port-security mac-address 0013.20B7.1232
SW1 (config-if)# switchport port-security violation shutdown
SW1 (config-if)# switchport port-security
SW1 (config-if)# ^Z
SW1 #
```

## Verify Port Security Violation

Connect another computer (with different mac-address) to switch port no. 2 and verify the output.

### SW1 – Verification:

SW1 # show interface status

```
Port    Name      Status    Vlan    Duplex  Speed Type
Fa0/1    connected  1        a-full  a-100  10/100BaseTX
Fa0/2    err-disabled  1        auto   auto   10/100BaseTX
Fa0/3    connected  1        a-full  a-100  10/100BaseTX
!
<output omitted>
!
Fa0/24   connected  1        a-full  a-100  10/100BaseTX
SW1#
```

SW1 # show port-security

| Secure Port | MaxSecureAddr<br>(Count) | CurrentAddr<br>(Count) | SecurityViolation<br>(Count) | Security Action |
|-------------|--------------------------|------------------------|------------------------------|-----------------|
| Fa0/2       | 1                        | 1                      | 1                            | Shutdown        |

```
Total Addresses in System (excluding one mac per port) : 0
Max Addresses limit in System (excluding one mac per port) : 1024
SW1 #
```



## Configure Port Security Recovery

SW1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW1 (config)# **errdisable recovery cause psecure-violation**

SW1 (config)# **errdisable recovery interval 30**

SW1 (config)# **exit**

SW1 # **show errdisable recovery**

| ErrDisable Reason | Timer Status |
|-------------------|--------------|
| -----             | -----        |
| udld              | Disabled     |
| bpdguard          | Disabled     |
| security-violatio | Disabled     |
| channel-misconfig | Disabled     |
| vmps              | Disabled     |
| pagp-flap         | Disabled     |
| dtp-flap          | Disabled     |
| link-flap         | Disabled     |
| psecure-violation | Enabled      |
| gbic-invalid      | Disabled     |
| dhcp-rate-limit   | Disabled     |
| unicast-flood     | Disabled     |
| loopback          | Disabled     |

Timer interval: 30 seconds

Interfaces that will be enabled at the next timeout:

| Interface | Errdisable reason | Time left(sec) |
|-----------|-------------------|----------------|
| -----     | -----             | -----          |
| Fa0/2     | psecure-violation | 15             |

SW1 #

**Repeat the above steps by reconfiguring violation command (restrict and protect) and verify the output.**

SW1 (config-if)# **switchport port-security violation restrict**

**OR**

SW1 (config-if)# **switchport port-security violation protect**

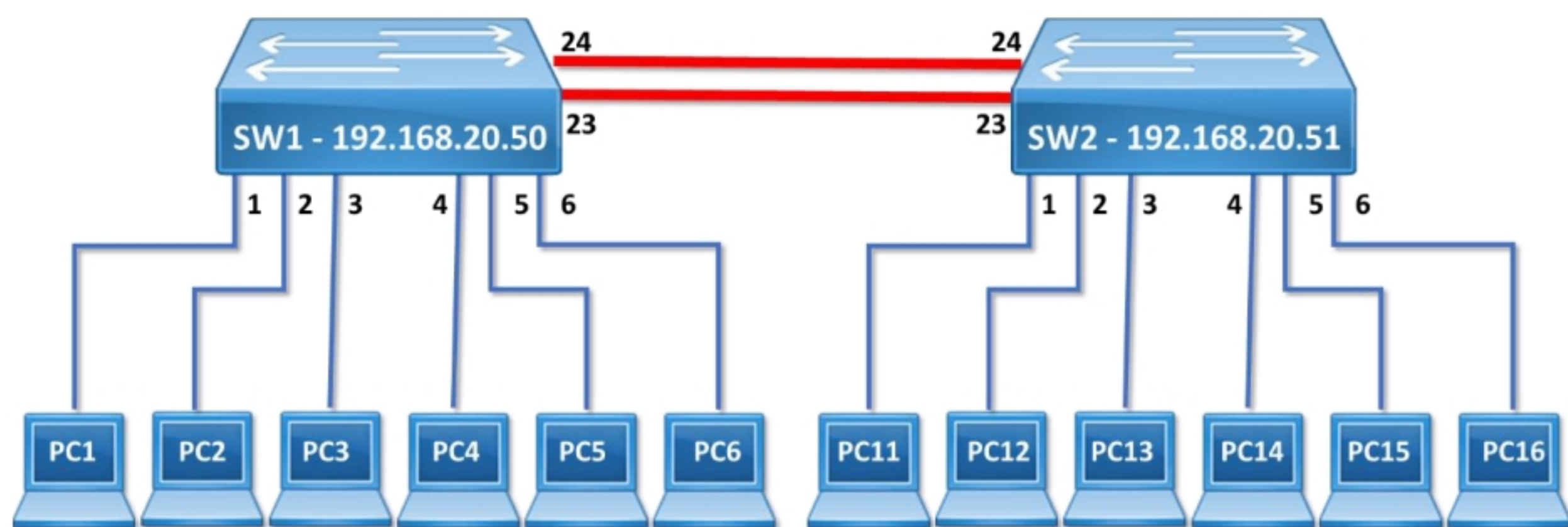
## LAB 26: SPANNING TREE PROTOCOL (STP)

### OBJECTIVE:

To understand the default behaviour of STP and how a root bridge election takes place.

### TOPOLOGY:

Setup Switch connectivity for the lab as below :



### TASK:

- Verify STP behaviour
- Change Priority to force a particular switch to become the Root Bridge
- Verify STP



## Verify STP default behaviour

### SW1 – Verification:

SW1 # show spanning-tree

VLAN0001

Spanning tree enabled protocol ieee

|         |            |                       |                |                      |
|---------|------------|-----------------------|----------------|----------------------|
| Root ID | Priority   | 32769                 |                |                      |
|         | Address    | 000c.8577.2040        |                |                      |
|         | Cost       | 19                    |                |                      |
|         | Port       | 23 (FastEthernet0/23) |                |                      |
|         | Hello Time | 2 sec                 | Max Age 20 sec | Forward Delay 15 sec |

|            |                |                                     |
|------------|----------------|-------------------------------------|
| Bridge ID  | Priority       | 32769 (priority 32768 sys-id-ext 1) |
| Address    | 000d.28f0.6840 |                                     |
| Hello Time | 2 sec          | Max Age 20 sec Forward Delay 15 sec |
| Aging Time | 15             |                                     |

| Interface | Role | Sts | Cost | Prio.Nbr | Type |
|-----------|------|-----|------|----------|------|
| Fa0/7     | Desg | FWD | 19   | 128.7    | P2p  |
| Fa0/11    | Desg | LIS | 19   | 128.11   | P2p  |
| Fa0/13    | Desg | FWD | 19   | 128.13   | P2p  |
| Fa0/19    | Desg | FWD | 19   | 128.19   | P2p  |
| Fa0/23    | Root | FWD | 19   | 128.23   | P2p  |
| Fa0/24    | Altn | BLK | 19   | 128.24   | P2p  |

SW1 #

### SW2 – Verification:

SW2 # show spanning-tree

VLAN0001

Spanning tree enabled protocol ieee

|         |                         |                |                |                      |
|---------|-------------------------|----------------|----------------|----------------------|
| Root ID | Priority                | 32769          |                |                      |
|         | Address                 | 000c.8577.2040 |                |                      |
|         | This bridge is the root |                |                |                      |
|         | Hello Time              | 2 sec          | Max Age 20 sec | Forward Delay 15 sec |

|            |                |                                     |
|------------|----------------|-------------------------------------|
| Bridge ID  | Priority       | 32769 (priority 32768 sys-id-ext 1) |
| Address    | 000c.8577.2040 |                                     |
| Hello Time | 2 sec          | Max Age 20 sec Forward Delay 15 sec |
| Aging Time | 15             |                                     |

| Interface | Role | Sts | Cost | Prio.Nbr | Type |
|-----------|------|-----|------|----------|------|
| Fa0/7     | Desg | FWD | 19   | 128.7    | P2p  |
| Fa0/13    | Desg | FWD | 19   | 128.13   | P2p  |
| Fa0/19    | Desg | FWD | 19   | 128.19   | P2p  |
| Fa0/23    | Desg | FWD | 19   | 128.23   | P2p  |
| Fa0/24    | Desg | FWD | 19   | 128.24   | P2p  |

SW2 #

## Configuring particular switch to become the Root Bridge

We can configure a switch to become the Root Bridge by giving **root primary** command which sets best bridge priority to become the root bridge. The switch with the lowest priority becomes the Root Bridge with all ports in forwarding state.

### SW1 – Configuration

```
SW1 (config) # spanning-tree vlan 1 root primary
SW1 (config) # end
SW1 #
```

### SW2 – Configuration

```
SW2 (config) # spanning-tree vlan 1 root secondary
SW2 (config) # end
SW2 #
```

## Verify STP

### SW1 – Verification:

```
SW1 # show spanning-tree
VLAN0001
```

```
Spanning tree enabled protocol ieee
```

```
Root ID    Priority      4097
           Address      000d.28f0.6840
           This bridge is the root
           Hello Time    2 sec    Max Age 20 sec    Forward Delay 15 sec
```

```
Bridge ID  Priority      4096 (priority 4096 sys-id-ext 1)
Address     000d.28f0.6840
Hello Time  2 sec           Max Age 20 sec    Forward Delay 15 sec
Aging Time  15
```

| Interface | Role | Sts | Cost | Prio.Nbr | Type |
|-----------|------|-----|------|----------|------|
| Fa0/7     | Desg | FWD | 19   | 128.7    | P2p  |
| Fa0/11    | Desg | LIS | 19   | 128.11   | P2p  |
| Fa0/13    | Desg | FWD | 19   | 128.13   | P2p  |
| Fa0/19    | Desg | FWD | 19   | 128.19   | P2p  |
| Fa0/23    | Desg | FWD | 19   | 128.23   | P2p  |
| Fa0/24    | Desg | FWD | 19   | 128.24   | P2p  |

```
SW1 #
```



## SW2 – Verification:

SW2 # show spanning-tree

VLAN0001

Spanning tree enabled protocol ieee

|         |            |                       |                |                      |
|---------|------------|-----------------------|----------------|----------------------|
| Root ID | Priority   | 4097                  |                |                      |
|         | Address    | 000d.28f0.6840        |                |                      |
|         | Cost       | 19                    |                |                      |
|         | Port       | 23 (FastEthernet0/23) |                |                      |
|         | Hello Time | 2 sec                 | Max Age 20 sec | Forward Delay 15 sec |

|           |            |                                     |                |                      |
|-----------|------------|-------------------------------------|----------------|----------------------|
| Bridge ID | Priority   | 28673 (priority 28672 sys-id-ext 1) |                |                      |
|           | Address    | 000c.8577.2040                      |                |                      |
|           | Hello Time | 2 sec                               | Max Age 20 sec | Forward Delay 15 sec |
|           | Aging Time | 15                                  |                |                      |

| Interface | Role | Sts | Cost | Prio.Nbr | Type |
|-----------|------|-----|------|----------|------|
| Fa0/7     | Desg | FWD | 19   | 128.7    | P2p  |
| Fa0/13    | Desg | FWD | 19   | 128.13   | P2p  |
| Fa0/19    | Desg | FWD | 19   | 128.19   | P2p  |
| Fa0/23    | Root | FWD | 19   | 128.23   | P2p  |
| Fa0/24    | Altn | BLK | 19   | 128.24   | P2p  |

SW2 #

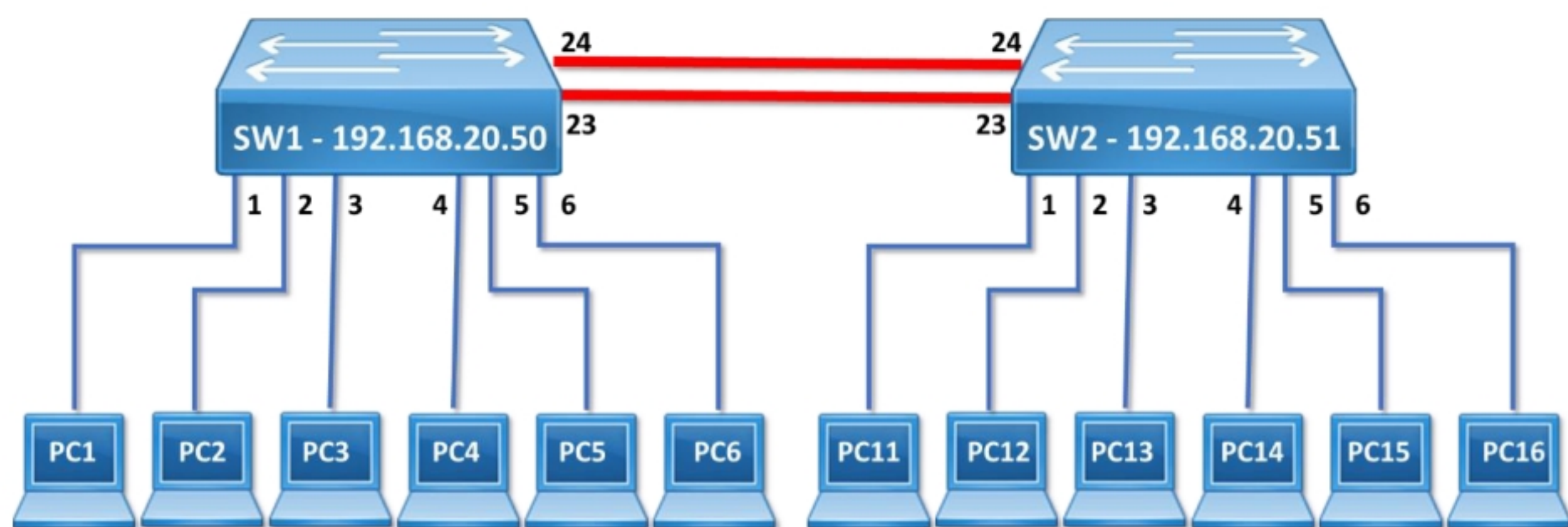
## LAB 27 : PORTFAST AND BPDU GUARD

### OBJECTIVE:

To understand the states of port in STP and difference after configuring Portfast and BPDU Guard.

### TOPOLOGY:

Setup Switch connectivity for the lab as below :



### TASK:

- Verify states of port in STP
- Configuring Portfast and BPDU guard for an Interface
- Verify states of port in STP
- Configuring Portfast and BPDU guard for a Switch
- Verify Portfast and BPDU Guard configuration for a switch

**Note :** PortFast is recommended only for those ports which are directly connected to PCs



## Verify Port State in STP after enabling Portfast

### SW1 – Configuration

SW1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW1 (config) # **interface fastethernet 0/11**

SW1 (config-if) # **shutdown**

SW1 (config-if) # **no shutdown**

SW1 (config-if) # **end**

SW1 #

### SW1 – Verification:

Now quickly give **show spanning-tree** mutiple times to view pstates.

SW1 # **show spanning-tree**

VLAN0001

Spanning tree enabled protocol ieee

|         |            |                       |                |                      |
|---------|------------|-----------------------|----------------|----------------------|
| Root ID | Priority   | 32769                 |                |                      |
|         | Address    | 000c.8577.2040        |                |                      |
|         | Cost       | 19                    |                |                      |
|         | Port       | 23 (FastEthernet0/23) |                |                      |
|         | Hello Time | 2 sec                 | Max Age 20 sec | Forward Delay 15 sec |

|            |                |                                     |                      |  |
|------------|----------------|-------------------------------------|----------------------|--|
| Bridge ID  | Priority       | 32769 (priority 32768 sys-id-ext 1) |                      |  |
| Address    | 000d.28f0.6840 |                                     |                      |  |
| Hello Time | 2 sec          | Max Age 20 sec                      | Forward Delay 15 sec |  |
| Aging Time | 15             |                                     |                      |  |

| Interface | Role | Sts | Cost | Prio.Nbr | Type |
|-----------|------|-----|------|----------|------|
| Fa0/7     | Desg | FWD | 19   | 128.7    | P2p  |
| Fa0/11    | Desg | BLK | 19   | 128.11   | P2p  |
| Fa0/13    | Desg | FWD | 19   | 128.13   | P2p  |
| Fa0/19    | Desg | FWD | 19   | 128.19   | P2p  |
| Fa0/23    | Root | FWD | 19   | 128.23   | P2p  |
| Fa0/24    | Altn | BLK | 19   | 128.24   | P2p  |

SW1 #

SW1 # **show spanning-tree**

VLAN0001

Spanning tree enabled protocol ieee

|         |            |                       |                |                      |
|---------|------------|-----------------------|----------------|----------------------|
| Root ID | Priority   | 32769                 |                |                      |
|         | Address    | 000c.8577.2040        |                |                      |
|         | Cost       | 19                    |                |                      |
|         | Port       | 23 (FastEthernet0/23) |                |                      |
|         | Hello Time | 2 sec                 | Max Age 20 sec | Forward Delay 15 sec |

```

Bridge ID   Priority       32769 (priority 32768 sys-id-ext 1)
Address     000d.28f0.6840
Hello Time  2 sec          Max Age 20 sec          Forward Delay 15 sec
Aging Time  15

```

| Interface | Role | Sts | Cost | Prio.Nbr | Type |
|-----------|------|-----|------|----------|------|
| Fa0/7     | Desg | FWD | 19   | 128.7    | P2p  |
| Fa0/11    | Desg | LIS | 19   | 128.11   | P2p  |
| Fa0/13    | Desg | FWD | 19   | 128.13   | P2p  |
| Fa0/19    | Desg | FWD | 19   | 128.19   | P2p  |
| Fa0/23    | Root | FWD | 19   | 128.23   | P2p  |
| Fa0/24    | Altn | BLK | 19   | 128.24   | P2p  |

SW1 #

#### SW1 # show spanning-tree

VLAN0001

Spanning tree enabled protocol ieee

```

Root ID    Priority       32769
           Address     000c.8577.2040
           Cost        19
           Port        23 (FastEthernet0/23)
           Hello Time  2 sec    Max Age 20 sec    Forward Delay 15 sec

```

```

Bridge ID   Priority       32769 (priority 32768 sys-id-ext 1)
Address     000d.28f0.6840
Hello Time  2 sec          Max Age 20 sec          Forward Delay 15 sec
Aging Time  15

```

| Interface | Role | Sts | Cost | Prio.Nbr | Type |
|-----------|------|-----|------|----------|------|
| Fa0/7     | Desg | FWD | 19   | 128.7    | P2p  |
| Fa0/11    | Desg | LRN | 19   | 128.11   | P2p  |
| Fa0/13    | Desg | FWD | 19   | 128.13   | P2p  |
| Fa0/19    | Desg | FWD | 19   | 128.19   | P2p  |
| Fa0/23    | Root | FWD | 19   | 128.23   | P2p  |
| Fa0/24    | Altn | BLK | 19   | 128.24   | P2p  |

SW1 #

#### SW1 # show spanning-tree

VLAN0001

Spanning tree enabled protocol ieee

```

Root ID    Priority       32769
           Address     000c.8577.2040
           Cost        19
           Port        23 (FastEthernet0/23)
           Hello Time  2 sec    Max Age 20 sec    Forward Delay 15 sec

```



```

Bridge ID   Priority      32769 (priority 32768 sys-id-ext 1)
Address     000d.28f0.6840
Hello Time  2 sec           Max Age 20 sec           Forward Delay 15 sec
Aging Time  15
  
```

| Interface | Role | Sts | Cost | Prio.Nbr | Type |
|-----------|------|-----|------|----------|------|
| Fa0/7     | Desg | FWD | 19   | 128.7    | P2p  |
| Fa0/11    | Desg | FWD | 19   | 128.11   | P2p  |
| Fa0/13    | Desg | FWD | 19   | 128.13   | P2p  |
| Fa0/19    | Desg | FWD | 19   | 128.19   | P2p  |
| Fa0/23    | Root | FWD | 19   | 128.23   | P2p  |
| Fa0/24    | Altn | BLK | 19   | 128.24   | P2p  |

SW1 #

### Configuring Portfast and BPDU guard for an Interface

#### SW1 – Configuration

##### SW1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW1 (config) # **interface fastethernet 0/11**

SW1 (config-if) # **spanning-tree portfast**

%Warning: portfast should only be enabled on ports connected to a single host. Connecting hubs, concentrators, switches, bridges, etc... to this interface when portfast is enabled, can cause temporary bridging loops.  
Use with CAUTION

%Portfast has been configured on FastEthernet0/1 but will only have effect when the interface is in a non-trunking mode.

SW1 (config-if) # **spanning-tree bpduguard enable**

SW1 (config-if) # **end**

SW1 #

### Verify Port State in STP after enabling Portfast

#### SW1 – Configuration

##### SW1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW1 (config) # **interface fastethernet 0/11**

SW1 (config-if) # **shutdown**

SW1 (config-if) # **no shutdown**

SW1 (config-if) # **end**

SW1 #

### SW1 – Verification:

Now quickly give **show spanning-tree** mutiple times to notice that Fa0/11 is placed into **FWD** state immediately.

SW1 # **show spanning-tree**

VLAN0001

Spanning tree enabled protocol ieee

```

Root ID    Priority      32769
           Address      000c.8577.2040
           Cost         19
           Port         23 (FastEthernet0/23)
           Hello Time    2 sec    Max Age 20 sec    Forward Delay 15 sec

```

```

Bridge ID  Priority      32769 (priority 32768 sys-id-ext 1)
Address    000d.28f0.6840
Hello Time 2 sec          Max Age 20 sec          Forward Delay 15 sec
Aging Time 15

```

| Interface | Role | Sts | Cost | Prio.Nbr | Type |
|-----------|------|-----|------|----------|------|
| -----     |      |     |      |          |      |
| Fa0/7     | Desg | FWD | 19   | 128.7    | P2p  |
| Fa0/11    | Desg | FWD | 19   | 128.11   | P2p  |
| Fa0/13    | Desg | FWD | 19   | 128.13   | P2p  |
| Fa0/19    | Desg | FWD | 19   | 128.19   | P2p  |
| Fa0/23    | Root | FWD | 19   | 128.23   | P2p  |
| Fa0/24    | Altn | BLK | 19   | 128.24   | P2p  |

SW1 #

### Configuring Postfast and BPDU guard for a Switch

SW1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW1 (config) # **spanning-tree portfast default**

%Warning: this command enables portfast by default on all interfaces. You should now disable portfast explicitly on switched ports leading to hubs, switches and bridges as they may create temporary bridging loops.

SW1 (config) # **spanning-tree portfast bpduguard default**

SW1 (config) # **end**

SW1 #



## Verify Portfast and BPDU Guard configuration for switch

### SW1 – Verification:

SW 1 # **show spanning-tree summary**

Switch is in pvst mode

Root bridge for: VLAN0001, VLAN0010, VLAN0020

EtherChannel misconfig guard is enabled

Extended system ID is enabled

Portfast Default is enabled

PortFast BPDU Guard Default is enabled

Portfast BPDU Filter Default is disabled

Loopguard Default is disabled

UplinkFast is disabled

BackboneFast is disabled

Pathcost method used is short

| Name     | Blocking | Listening | Learning | Forwarding | STP Active |
|----------|----------|-----------|----------|------------|------------|
| -----    | -----    | -----     | -----    | -----      | -----      |
| VLAN0001 | 0        | 0         | 0        | 8          | 8          |
| VLAN0010 | 0        | 0         | 0        | 3          | 3          |
| VLAN0020 | 0        | 0         | 0        | 3          | 3          |
| -----    | -----    | -----     | -----    | -----      | -----      |
| 3 vlans  | 0        | 0         | 0        | 14         | 14         |

SW1 #

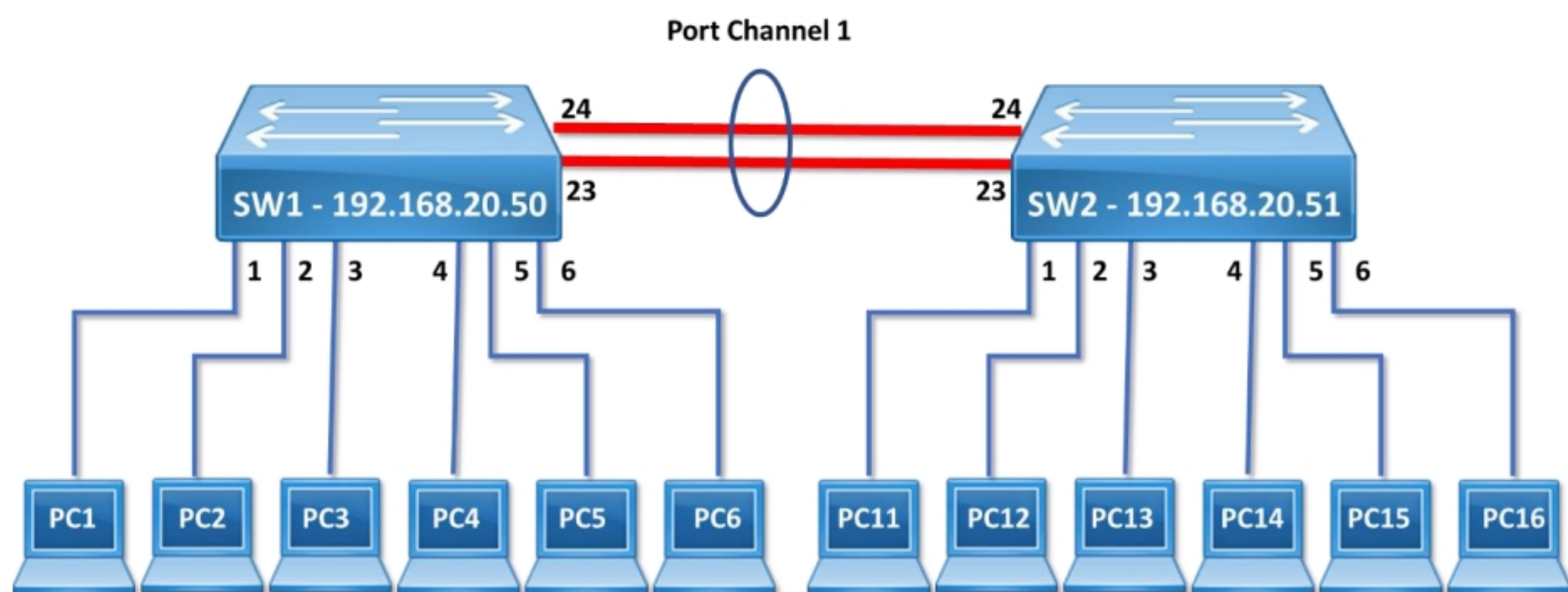
## LAB 28: ETHERCHANNEL

### OBJECTIVE:

To configure Etherchannel for link aggregation

### TOPOLOGY:

Setup Switch connectivity for the lab as below :



### TASK:

- Configure Etherchannel
- Verify Etherchannel



## Configure Etherchannel

### SW1 – Etherchannel Configuration

SW1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW1 (config) # **interface range fa 0/23 -24**

SW1 (config-if-range) # **channel-group 1 mode on**

Creating a port-channel interface Port-channel 1

SW1 (config-if-range) # **end**

SW1 #

### SW2 – Etherchannel Configuration

SW2 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

SW2 (config) # **interface range fa 0/23 -24**

SW2 (config-if-range) # **channel-group 1 mode on**

Creating a port-channel interface Port-channel 1

SW2 (config-if-range) # **end**

SW2 #

## Verify Etherchannel

### SW1 – Verification:

SW1 # **show etherchannel 1 summary**

Flags: D - down          P - bundled in port-channel  
 I - stand-alone    s - suspended  
 H - Hot-standby (LACP only)  
 R - Layer 2        S - Layer 3  
 U - in use          f - failed to allocate aggregator

M - not in use, minimum links not met

u - unsuitable for bundling

w - waiting to be aggregated

d - default port

Number of channel-groups in use: 1

Number of aggregators: 1

| Group | Port-channel | Protocol | Ports               |
|-------|--------------|----------|---------------------|
| 1     | Po1(SU)      | -        | Fa0/23(P) Fa0/24(P) |

SW1 #

# SW1 # show interface port-channel 1

```
Port-channel1 is up, line protocol is up (connected)
Hardware is EtherChannel, address is 000f.8f16.3c17 (bia 000f.8f16.3c17)
MTU 1500 bytes, BW 200000 Kbit, DLY 1000 usec,
  reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ARPA, loopback not set
Full-duplex, 100Mb/s, media type is unknown media type
input flow-control is off, output flow-control is off
Members in this channel: Fa0/23 Fa0/24
ARP type: ARPA, ARP Timeout 04:00:00
Last input 00:00:49, output 00:00:01, output hang never
Last clearing of "show interface" counters never
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
  247 packets input, 18093 bytes, 0 no buffer
    0 runs, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
    0 input packets with dribble condition detected
  222 packets output, 15835 bytes, 0 underruns
    0 output errors, 0 collisions, 1 interface resets
    0 babbles, 0 late collision, 0 deferred
    0 lost carrier, 0 no carrier, 0 PAUSE output
    0 output buffer failures, 0 output buffers swapped out
```

# SW1 # show etherchannel port-channel

Channel-group listing:

Group: 1

Port-channels in the group:

Port-channel: Po1

Age of the Port-channel = 0d:00h:10m:05s

|                   |                         |                        |
|-------------------|-------------------------|------------------------|
| Logical slot/port | = 1/0                   | Number of ports = 2    |
| GC                | = 0x00000000            | HotStandBy port = null |
| Port state        | = Port-channel Ag-Inuse |                        |
| Protocol          | = -                     |                        |

Ports in the Port-channel:

| Index | Load | Port   | EC state | No of bits |
|-------|------|--------|----------|------------|
| 0     | 00   | Fa0/23 | On/FEC   | 0          |
| 0     | 00   | Fa0/24 | On/FEC   | 0          |

Time since last port bundled: 0d:00h:20m:05s Fa0/24



# SW1 # show interface status

```

Port    Name      Status    Vlan    Duplex  Speed Type
Fa0/1    notconnect  1         auto   auto 10/100BaseTX
Fa0/2    notconnect  1         auto   auto 10/100BaseTX
!
<output omitted>
!
Fa0/21    notconnect  1         auto   auto 10/100BaseTX
Fa0/22    notconnect  1         auto   auto 10/100BaseTX
Fa0/23    connected  1         a-full a-100 10/100BaseTX
Fa0/24    connected  1         a-full a-100 10/100BaseTX
Po1       connected  1         a-full a-100

```

# SW1 # show spanning-tree

## VLAN0001

Spanning tree enabled protocol ieee

```

Root ID    Priority    32769
           Address    000c.8577.2040
           Cost      19
           Port      23 (FastEthernet0/23)
           Hello Time 2 sec    Max Age 20 sec    Forward Delay 15 sec

```

```

Bridge ID  Priority    32769 (priority 32768 sys-id-ext 1)
Address    000d.28f0.6840
Hello Time 2 sec    Max Age 20 sec    Forward Delay 15 sec
Aging Time 15

```

| Interface | Role | Sts | Cost | Prio.Nbr | Type |
|-----------|------|-----|------|----------|------|
| Fa0/7     | Desg | FWD | 19   | 128.7    | P2p  |
| Fa0/11    | Desg | FWD | 19   | 128.11   | P2p  |
| Fa0/19    | Desg | FWD | 19   | 128.13   | P2p  |
| Fa0/20    | Desg | FWD | 19   | 128.19   | P2p  |
| Fa0/21    | Root | FWD | 19   | 128.23   | P2p  |
| Fa0/22    | Altn | BLK | 19   | 128.24   | P2p  |
| Po1       | Desg | FWD | 12   | 128.65   | P2p  |

SW1 #

## SW2 – Verification:

### SW2 # show etherchannel 1 summary

Flags: D - down P - bundled in port-channel  
 I - stand-alone s - suspended  
 H - Hot-standby (LACP only)  
 R - LayeBAN S - LayeHYD-1  
 U - in use f - failed to allocate aggregator

M - not in use, minimum links not met  
 u - unsuitable for bundling  
 w - waiting to be aggregated  
 d - default port

Number of channel-groups in use: 1

Number of aggregators: 1

| Group | Port-channel | Protocol | Ports               |
|-------|--------------|----------|---------------------|
| 1     | Po1(SU)      | -        | Fa0/23(P) Fa0/24(P) |

SW2 #

### SW2 # show interface port-channel 1

Port-channel1 is up, line protocol is up (connected)  
 Hardware is EtherChannel, address is 000f.8f16.3c17 (bia 000f.8f16.3c17)  
 MTU 1500 bytes, BW 200000 Kbit, DLY 1000 usec,  
 reliability 255/255, txload 1/255, rxload 1/255  
 Encapsulation ARPA, loopback not set  
 Full-duplex, 100Mb/s, media type is unknown media type  
 input flow-control is off, output flow-control is off  
 Members in this channel: Fa0/23 Fa0/24  
 ARP type: ARPA, ARP Timeout 04:00:00  
 Last input 00:00:49, output 00:00:01, output hang never  
 Last clearing of "show interface" counters never  
 Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0  
 Queueing strategy: fifo  
 Output queue: 0/40 (size/max)  
 5 minute input rate 0 bits/sec, 0 packets/sec  
 5 minute output rate 0 bits/sec, 0 packets/sec  
 247 packets input, 18093 bytes, 0 no buffer  
 0 runts, 0 giants, 0 throttles  
 0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored  
 0 input packets with dribble condition detected  
 222 packets output, 15835 bytes, 0 underruns  
 0 output errors, 0 collisions, 1 interface resets  
 0 babbles, 0 late collision, 0 deferred  
 0 lost carrier, 0 no carrier, 0 PAUSE output  
 0 output buffer failures, 0 output buffers swapped out



## SW2 # show etherchannel port-channel

Channel-group listing:

-----  
Group: 1  
-----

Port-channels in the group:  
-----

Port-channel: Po1  
-----

Age of the Port-channel = 0d:00h:10m:05s

Logical slot/port = 1/0

Number of ports = 2

GC = 0x00000000

HotStandBy port = null

Port state = Port-channel Ag-Inuse

Protocol = -

Ports in the Port-channel:

| Index | Load | Port   | EC state | No of bits |
|-------|------|--------|----------|------------|
| 0     | 00   | Fa0/23 | On/FEC   | 0          |
| 0     | 00   | Fa0/24 | On/FEC   | 0          |

-----+-----+-----+-----+-----

Time since last port bundled: 0d:00h:20m:05s Fa0/24

## SW2 # show interface status

| Port             | Name | Status     | Vlan | Duplex | Speed | Type         |
|------------------|------|------------|------|--------|-------|--------------|
| Fa0/1            |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/2            |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| !                |      |            |      |        |       |              |
| <output omitted> |      |            |      |        |       |              |
| !                |      |            |      |        |       |              |
| Fa0/21           |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/22           |      | notconnect | 1    | auto   | auto  | 10/100BaseTX |
| Fa0/23           |      | connected  | 1    | a-full | a-100 | 10/100BaseTX |
| Fa0/24           |      | connected  | 1    | a-full | a-100 | 10/100BaseTX |
| Po1              |      | connected  | 1    | a-full | a-100 |              |

## SW2 # show spanning-tree

VLAN0001

Spanning tree enabled protocol ieee

|         |            |                       |                |                      |
|---------|------------|-----------------------|----------------|----------------------|
| Root ID | Priority   | 4097                  |                |                      |
|         | Address    | 000d.28f0.6840        |                |                      |
|         | Cost       | 19                    |                |                      |
|         | Port       | 23 (FastEthernet0/23) |                |                      |
|         | Hello Time | 2 sec                 | Max Age 20 sec | Forward Delay 15 sec |

|            |                |                                     |                      |  |
|------------|----------------|-------------------------------------|----------------------|--|
| Bridge ID  | Priority       | 28673 (priority 28672 sys-id-ext 1) |                      |  |
| Address    | 000c.8577.2040 |                                     |                      |  |
| Hello Time | 2 sec          | Max Age 20 sec                      | Forward Delay 15 sec |  |
| Aging Time | 15             |                                     |                      |  |

| Interface | Role | Sts | Cost | Prio.Nbr | Type |
|-----------|------|-----|------|----------|------|
| <hr/>     |      |     |      |          |      |
| Fa0/7     | Desg | FWD | 19   | 128.7    | P2p  |
| Fa0/11    | Desg | FWD | 19   | 128.11   | P2p  |
| Fa0/19    | Desg | FWD | 19   | 128.13   | P2p  |
| Fa0/20    | Desg | FWD | 19   | 128.19   | P2p  |
| Fa0/21    | Root | FWD | 19   | 128.23   | P2p  |
| Fa0/22    | Altn | BLK | 19   | 128.24   | P2p  |
| Po1       | Desg | FWD | 12   | 128.65   | P2p  |

SW2 #



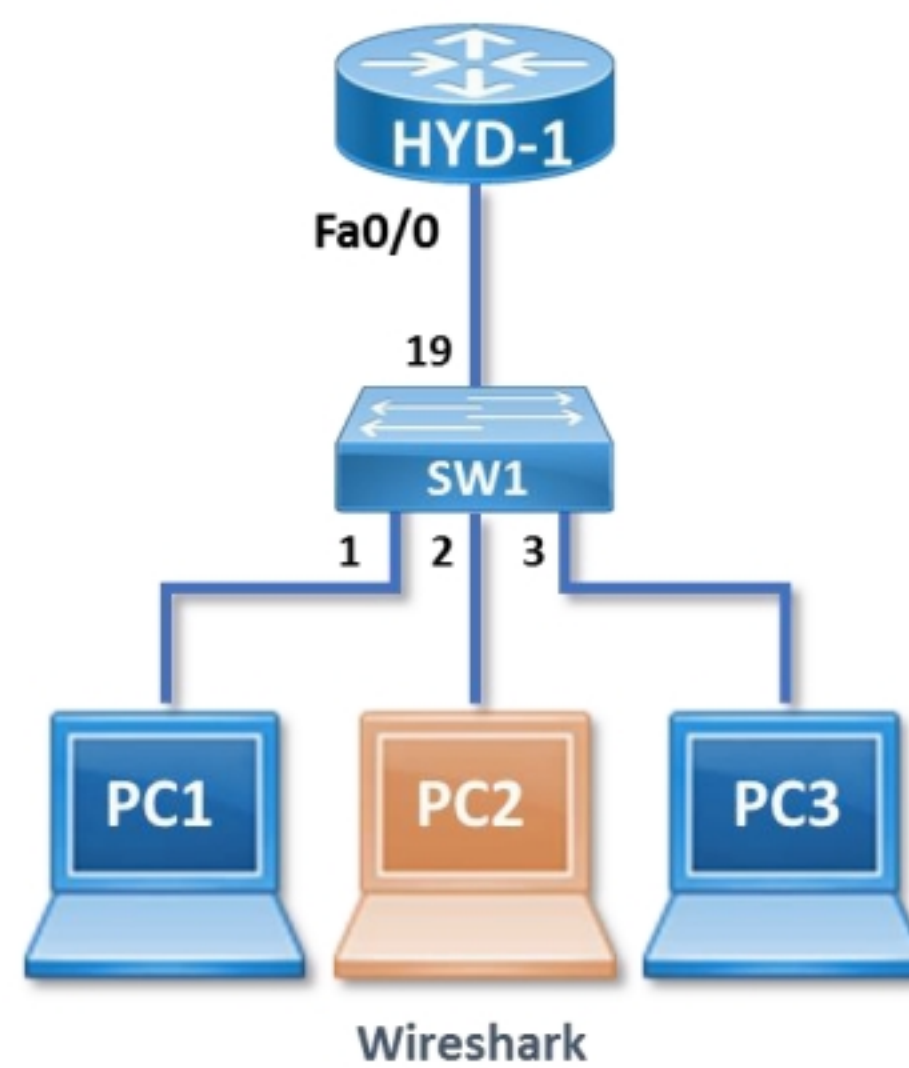
## LAB 29: SWITCHED PORT ANALYZER (SPAN)

### OBJECTIVE:

To enable SPAN on switch port for capturing data traffic.

### TOPOLOGY:

Setup Switch connectivity for the lab as below:



**Pre-requisite:** Computer should have Wireshark software installed and running.

### TASK:

- Enable SPAN
- Verify SPAN

## Enabling SPAN

### SW1 # configure terminal

Enter configuration commands, one per line. End with CNTL/Z.

SW1(config)# **monitor session 1 source interface fastEthernet 0/11**

SW1(config)# **monitor session 1 destination interface fastEthernet 0/2**

SW1 #

## Verify SPAN

### SW1 – Verification:

### SW1 # show monitor

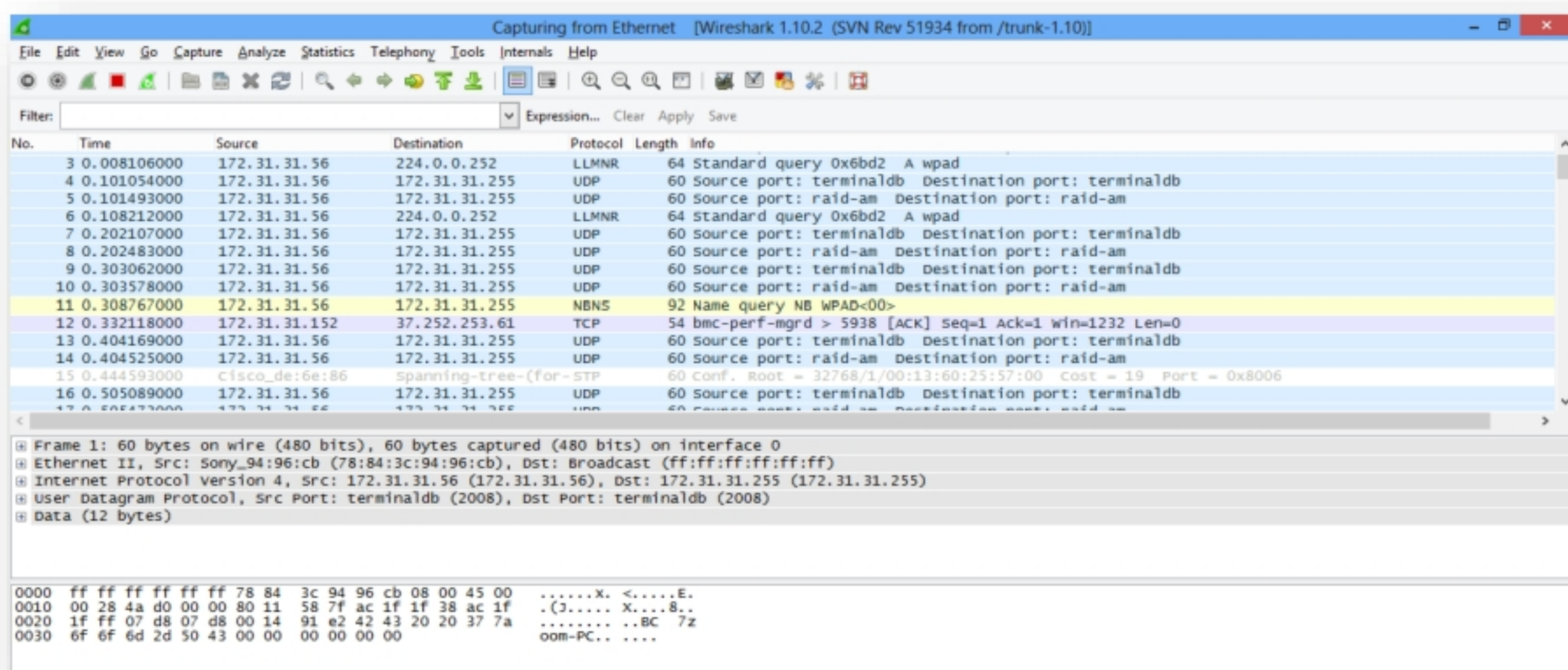
#### Session 1

```

Type : Local Session
Source Ports :
  Both : Fa0/9
Destination Ports : Fa0/8
Encapsulation : Native
Ingress : Disabled
  
```

## Verification on Computer with Wireshark (PC2) :

- Start **Wireshark** Application on PC2 and click **START** button for capturing packets.
- Now Telnet the Router from PC1.
- Verify the packet capturing activity on Wireshark





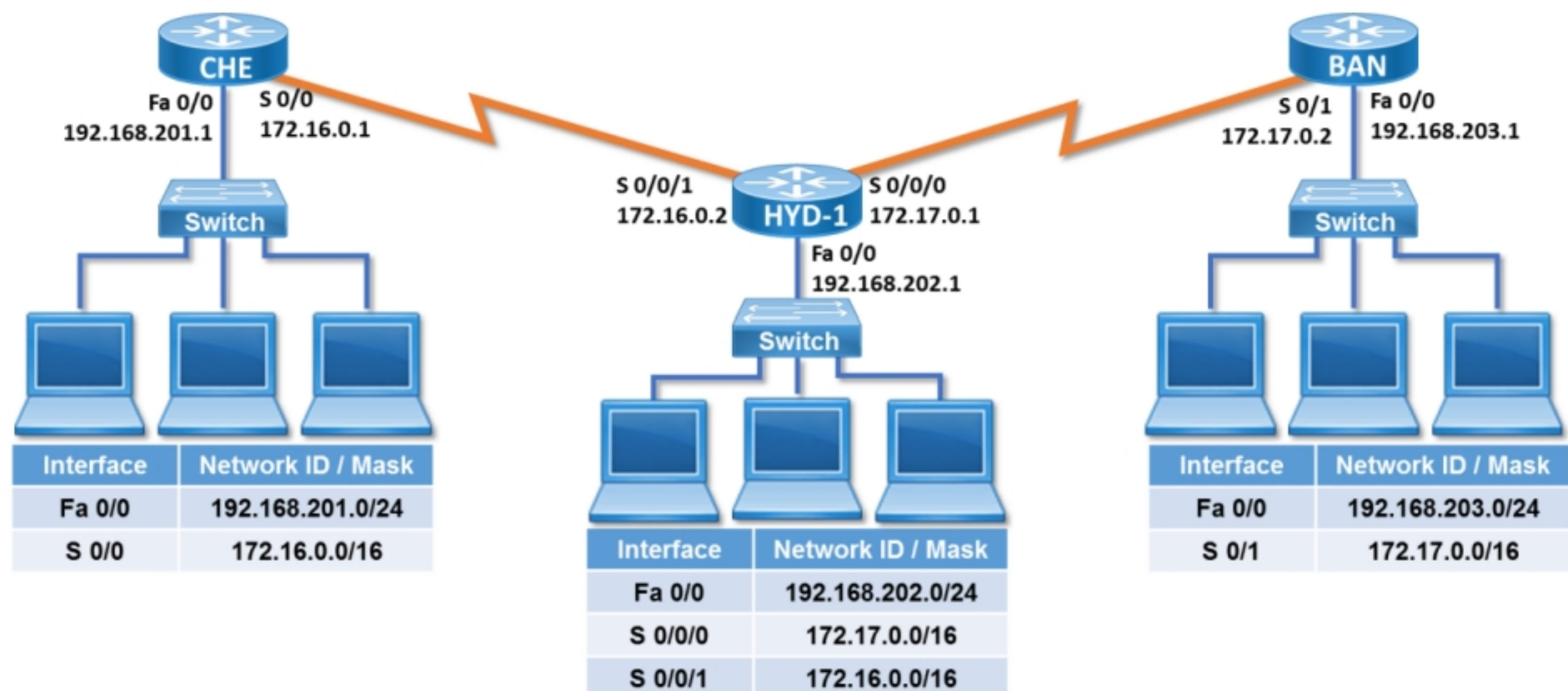
## LAB 30: STANDARD ACCESS CONTROL LIST ON IPv4 NETWORK (NUMBERED)

### OBJECTIVE:

To configure and implement access-list on HYD-1 such that 192.168.201.10 should not communicate with 192.168.202.0 network

### TOPOLOGY:

Configure Ethernet and Serial IP addresses for the lab as below :



**Pre-requisite:** WAN Interface and Routing configuration to be done on the router (LAB – 3 and 4)

### TASK:

- Verify communication between computers / networks before configuring the access list
- Configure and implement Standard ACL - Numbered
- Verify blocked communication between computers / networks specified in ACL

## Verify communication between computers / networks before configuring the access list

### From 192.168.201.10 Computer in CHE Network

#### **ping 192.168.202.10**

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.  
64 bytes from 192.168.202.10: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.202.10: icmp\_seq=4 ttl=62 time=24.0 ms

#### **ping 192.168.203.10**

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
64 bytes from 192.168.203.10: icmp\_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.203.10: icmp\_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.203.10: icmp\_seq=29 ttl=62 time=24.2 ms

### From 192.168.202.20 computer in CHE Network

#### **ping 192.168.202.10**

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.  
64 bytes from 192.168.202.10: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.202.10: icmp\_seq=4 ttl=62 time=24.0 ms

#### **ping 192.168.203.10**

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
64 bytes from 192.168.203.10: icmp\_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.203.10: icmp\_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.203.10: icmp\_seq=29 ttl=62 time=24.2 ms



## Configure and Implement Standard ACL - Numbered

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **access-list 10 deny 192.168.201.10 0.0.0.0**

HYD-1 (config) # **access-list 10 permit any**

HYD-1 (config) #

HYD-1 (config) # **interface FastEthernet 0/0**

HYD-1 (config-if) # **ip access-group 1 out**

HYD-1 (config-if) # **end**

HYD-1 #

### HYD-1 – Verification:

HYD-1 # **show ip access-lists**

Standard IP access list 10

10 deny 192.168.201.10

20 permit any

HYD-1#

HYD-1 # **show ip interface FastEthernet 0/0**

FastEthernet0/0 is up, line protocol is up

Internet address is 192.168.202.1/24

Broadcast address is 255.255.255.255

Address determined by setup command

MTU is 1500 bytes

Helper address is not set

Directed broadcast forwarding is disabled

Outgoing access list is 10

Inbound access list is not set

Proxy ARP is enabled

Local Proxy ARP is disabled

Security level is default

Split horizon is enabled

!

<output omitted>

!

WCCP Redirect outbound is disabled

WCCP Redirect inbound is disabled

WCCP Redirect exclude is disabled

HYD-1#

## Verify blocked communication between computers / networks specified in ACL

### From 192.168.201.10 computer in CHE Network

#### **ping 192.168.202.10**

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.  
From 192.168.202.1 icmp\_seq=1 Packet filtered  
From 192.168.202.1 icmp\_seq=2 Packet filtered  
From 192.168.202.1 icmp\_seq=3 Packet filtered  
From 192.168.202.1 icmp\_seq=4 Packet filtered  
From 192.168.202.1 icmp\_seq=5 Packet filtered

#### **ping 192.168.203.10**

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
64 bytes from 192.168.203.10: icmp\_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.203.10: icmp\_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.203.10: icmp\_seq=29 ttl=62 time=24.2 ms

### From 192.168.201.20 computer in CHE Network

#### **ping 192.168.202.10**

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.  
64 bytes from 192.168.202.10: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.202.10: icmp\_seq=4 ttl=62 time=24.0 ms

#### **ping 192.168.203.10**

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
64 bytes from 192.168.203.10: icmp\_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.203.10: icmp\_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.203.10: icmp\_seq=29 ttl=62 time=24.2 ms



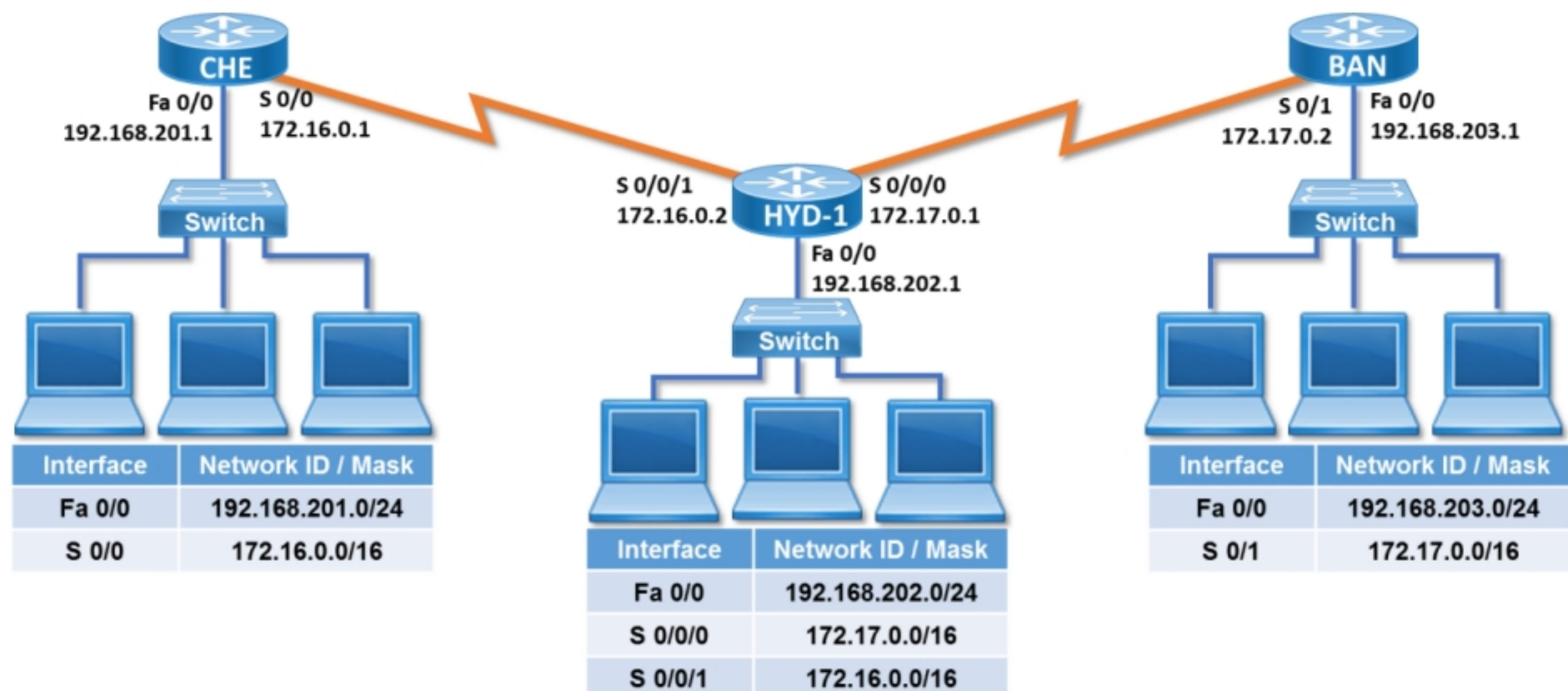
## LAB 31: STANDARD ACCESS CONTROL LIST ON IPv4 NETWORK (NAMED)

### OBJECTIVE:

To configure and implement access-list on HYD-1 such that 192.168.203.10 should only communicate with 192.168.202.0 network. (Configure ACL with minimum statements)

### TOPOLOGY:

Configure Ethernet and Serial IP addresses for the lab as below :



**Pre-requisite:** WAN Interface and Routing configuration to be done on the router (LAB – 3 and 4)

### TASK:

- Verify communication between computers / networks before configuring the access list
- Configure and implement Standard ACL - Named
- Verify blocked communication between computers / networks specified in ACL

## Verify communication between computers / networks before configuring the access list

### From 192.168.201.10 Computer in CHE Network

#### **ping 192.168.202.10**

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.  
64 bytes from 192.168.202.10: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.202.10: icmp\_seq=4 ttl=62 time=24.0 ms

#### **ping 192.168.203.10**

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
64 bytes from 192.168.203.10: icmp\_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.203.10: icmp\_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.203.10: icmp\_seq=29 ttl=62 time=24.2 ms

### From 192.168.202.20 computer in CHE Network

#### **ping 192.168.202.10**

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.  
64 bytes from 192.168.202.10: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.202.10: icmp\_seq=4 ttl=62 time=24.0 ms

#### **ping 192.168.203.10**

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
64 bytes from 192.168.203.10: icmp\_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.203.10: icmp\_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.203.10: icmp\_seq=29 ttl=62 time=24.2 ms



**From 192.168.203.10 Computer in BAN Network****ping 192.168.202.10**

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.  
64 bytes from 192.168.202.10: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.202.10: icmp\_seq=4 ttl=62 time=24.0 ms

**ping 192.168.201.10**

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.  
64 bytes from 192.168.201.10: icmp\_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp\_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp\_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.201.10: icmp\_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.201.10: icmp\_seq=29 ttl=62 time=24.2 ms

**From 192.168.203.20 computer in BAN Network****ping 192.168.202.10**

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.  
64 bytes from 192.168.202.10: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.202.10: icmp\_seq=4 ttl=62 time=24.0 ms

**ping 192.168.201.10**

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.  
64 bytes from 192.168.201.10: icmp\_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp\_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp\_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.201.10: icmp\_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.201.10: icmp\_seq=29 ttl=62 time=24.2 ms

## Configure and Implement Standard ACL - Named

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ip access-list standard zoom**

HYD-1 (config-std-nacl) # **permit 192.168.203.10 0.0.0.0**

HYD-1 (config-std-nacl) # **exit**

HYD-1 (config) #

HYD-1 (config) # **interface fastethernet 0/0**

HYD-1 (config-if) # **ip access-group zoom out**

HYD-1 (config-if) # **end**

HYD-1 #

### HYD-1 – Verification:

HYD-1 # **show ip access-lists**

Standard IP access list zoom

10 permit 192.168.203.10

HYD-1#

HYD-1 # **show ip interface FastEthernet 0/0**

FastEthernet0/0 is up, line protocol is up

Internet address is 192.168.202.1/24

Broadcast address is 255.255.255.255

Address determined by setup command

MTU is 1500 bytes

Helper address is not set

Directed broadcast forwarding is disabled

Outgoing access list is zoom

Inbound access list is not set

Proxy ARP is enabled

Local Proxy ARP is disabled

Security level is default

Split horizon is enabled

!

<output omitted>

!

WCCP Redirect outbound is disabled

WCCP Redirect inbound is disabled

WCCP Redirect exclude is disabled

HYD-1#



## Verify blocked communication between computers / networks specified in ACL

### From 192.168.201.10 Computer in CHE Network

#### **ping 192.168.202.10**

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.  
From 192.168.202.1 icmp\_seq=1 Packet filtered  
From 192.168.202.1 icmp\_seq=2 Packet filtered  
From 192.168.202.1 icmp\_seq=3 Packet filtered  
From 192.168.202.1 icmp\_seq=4 Packet filtered  
From 192.168.202.1 icmp\_seq=5 Packet filtered

#### **ping 192.168.203.10**

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
64 bytes from 192.168.203.10: icmp\_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.203.10: icmp\_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.203.10: icmp\_seq=29 ttl=62 time=24.2 ms

### From 192.168.202.20 computer in CHE Network

#### **ping 192.168.202.10**

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.  
From 192.168.202.1 icmp\_seq=1 Packet filtered  
From 192.168.202.1 icmp\_seq=2 Packet filtered  
From 192.168.202.1 icmp\_seq=3 Packet filtered  
From 192.168.202.1 icmp\_seq=4 Packet filtered  
From 192.168.202.1 icmp\_seq=5 Packet filtered

#### **ping 192.168.203.10**

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
64 bytes from 192.168.203.10: icmp\_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.203.10: icmp\_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.203.10: icmp\_seq=29 ttl=62 time=24.2 ms

**From 192.168.203.10 Computer in BAN Network****ping 192.168.202.10**

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.  
64 bytes from 192.168.202.10: icmp\_seq=1 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=2 ttl=62 time=24.0 ms  
64 bytes from 192.168.202.10: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.202.10: icmp\_seq=4 ttl=62 time=24.0 ms

**ping 192.168.201.10**

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.  
64 bytes from 192.168.201.10: icmp\_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp\_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp\_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.201.10: icmp\_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.201.10: icmp\_seq=29 ttl=62 time=24.2 ms

**From 192.168.203.20 computer in BAN Network****ping 192.168.202.10**

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.  
From 192.168.202.1 icmp\_seq=1 Packet filtered  
From 192.168.202.1 icmp\_seq=2 Packet filtered  
From 192.168.202.1 icmp\_seq=3 Packet filtered  
From 192.168.202.1 icmp\_seq=4 Packet filtered  
From 192.168.202.1 icmp\_seq=5 Packet filtered

**ping 192.168.201.10**

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.  
64 bytes from 192.168.201.10: icmp\_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp\_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp\_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.201.10: icmp\_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.201.10: icmp\_seq=29 ttl=62 time=24.2 ms



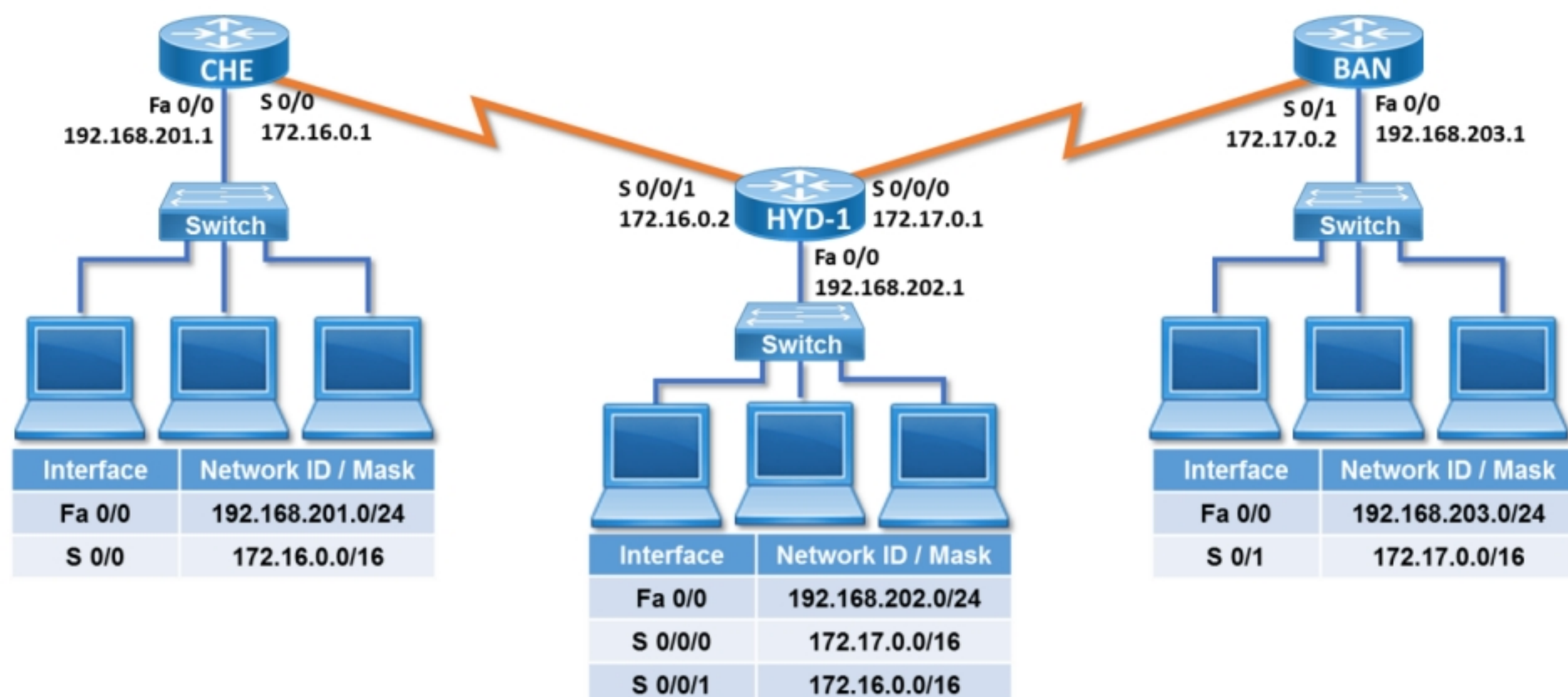
## LAB 32: EXTENDED ACCESS CONTROL LIST ON IPv4 NETWORK (NUMBERED)

### OBJECTIVE:

Deny HYD-1 Network (i.e. 192.168.202.0/24) from accessing HTTP server (i.e. 192.168.203.10) in BAN Network and also deny ping to CHE Network (i.e. 192.168.201.0/24)

### TOPOLOGY:

Configure Ethernet and Serial IP addresses for the lab as below :



**Pre-requisite:** WAN Interface and Routing configuration to be done on the router (LAB – 3 and 4)

### TASK:

- Verify services and communication between computers / networks before configuring the extended access list.
- Configure and implement Extended ACL - Numbered
- Verify blocked services and communication between computers / networks specified in ACL

**Verify services and communication between computers / networks before configuring the****Extended Access List****From 192.168.202.10 Computer in HYD-1 Network****ping 192.168.201.10**

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.  
64 bytes from 192.168.201.10: icmp\_seq=1 ttl=62 time=24.2 ms  
64 bytes from 192.168.201.10: icmp\_seq=2 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp\_seq=4 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp\_seq=5 ttl=62 time=24.1 ms

**ping 192.168.203.10**

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
64 bytes from 192.168.203.10: icmp\_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.203.10: icmp\_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.203.10: icmp\_seq=29 ttl=62 time=24.2 ms

**Try to access HTTP Server via browser (i.e. <http://192.168.203.10>)**

You should be able to see Test web page, indicates http service is allowed.

**Repeat the above verification from 192.168.202.20 Computer in HYD-1 Network and verify the outputs**



## Configure and Implement Extended ACL - Numbered

### HYD-1 – Configuration

#### HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **access-list 101 deny tcp 192.168.202.0 0.255.255.255 192.168.203.10 0.0.0.0 eq www**

HYD-1 (config) # **access-list 101 deny icmp 192.168.202.0 0.255.255.255 192.168.201.0 0.0.0.255 echo**

HYD-1 (config) # **access-list 101 permit ip any any**

HYD-1 (config) # **interface FastEthernet 0/0**

HYD-1 (config-if) # **ip access-group 101 in**

HYD-1 (config-if) # **exit**

### HYD-1 – Verification:

#### HYD-1 # **show ip access-lists**

Extended IP access list 101

10 deny tcp 192.168.202.0 0.255.255.255 host 192.168.203.10 eq www (5 matches)

20 deny icmp 192.168.202.0 0.255.255.255 192.168.201.0 0.0.0.255 echo (10 matches)

30 permit ip any any (87 matches)

HYD-1#

#### HYD-1 # **show ip interface FastEthernet 0/0**

FastEthernet0/0 is up, line protocol is up

Internet address is 192.168.202.1/24

Broadcast address is 255.255.255.255

Address determined by setup command

MTU is 1500 bytes

Helper address is not set

Directed broadcast forwarding is disabled

Multicast reserved groups joined: 224.0.0.5 224.0.0.6

Outgoing access list is not set

Inbound access list is 101

Proxy ARP is enabled

Local Proxy ARP is disabled

Security level is default

Split horizon is enabled

!

<output omitted>

!

WCCP Redirect outbound is disabled

WCCP Redirect inbound is disabled

WCCP Redirect exclude is disabled

HYD-1#

**Verify blocked services and communication between computers / networks specified in ACL****From 192.168.202.10 Computer in HYD-1 Network****ping 192.168.201.10**

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.  
From 192.168.202.1 icmp\_seq=1 Packet filtered  
From 192.168.202.1 icmp\_seq=2 Packet filtered  
From 192.168.202.1 icmp\_seq=3 Packet filtered  
From 192.168.202.1 icmp\_seq=4 Packet filtered  
From 192.168.202.1 icmp\_seq=5 Packet filtered

**ping 192.168.203.10**

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
64 bytes from 192.168.203.10: icmp\_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.203.10: icmp\_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.203.10: icmp\_seq=29 ttl=62 time=24.2 ms

**Try to access HTTP Server via browser (i.e. <http://192.168.203.10>)**

You should not be able to see Test web page, indicates http service is blocked.

**Repeat the above verification from 192.168.202.20 Computer in HYD-1 Network and verify the outputs**



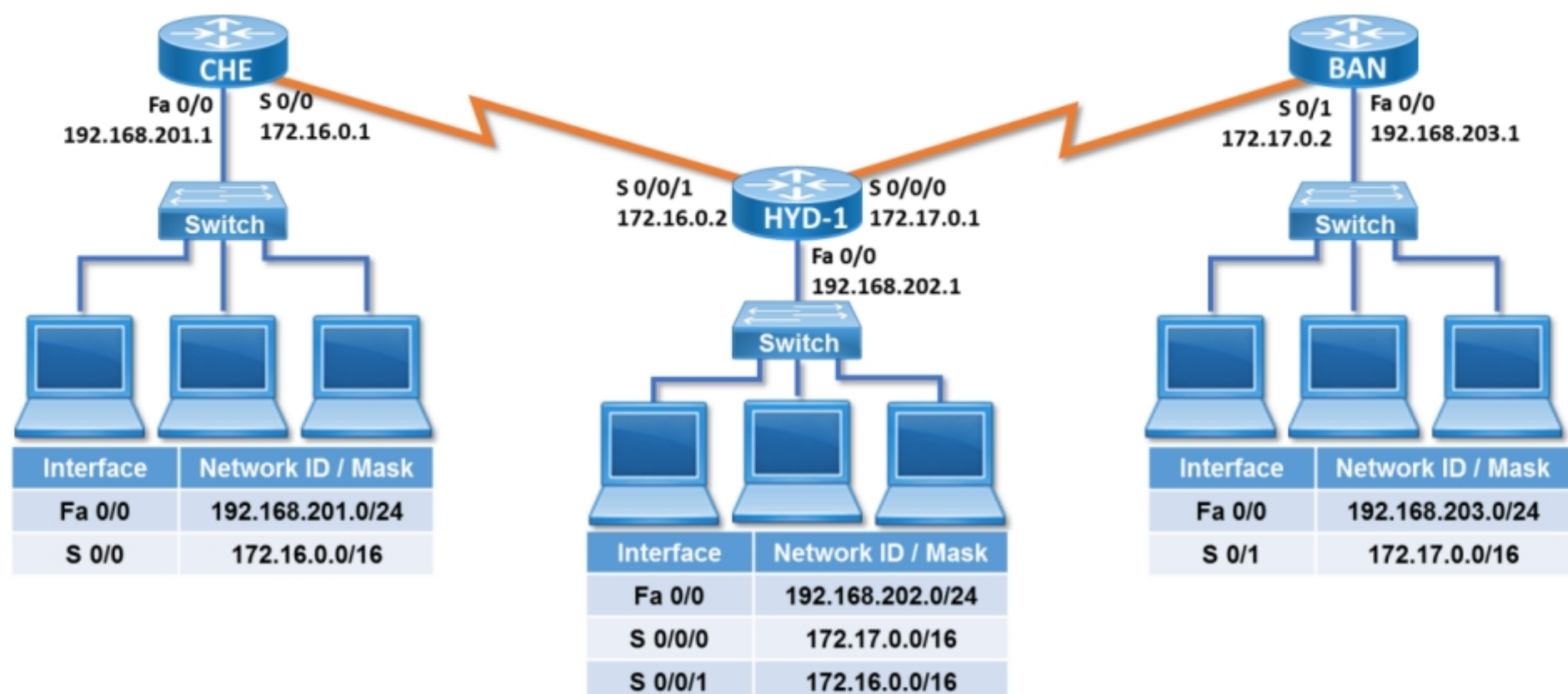
## LAB 33: EXTENDED ACCESS CONTROL LIST ON IPv4 NETWORK (NAMED)

### OBJECTIVE:

Allow PC from HYD-1 Network (i.e. 192.168.202.10/24) to access FTP server (i.e. 192.168.201.10) in CHE Network. (Configure ACL with minimum statements)

### TOPOLOGY:

Configure Ethernet and Serial IP addresses for the lab as below :



**Pre-requisite:** WAN Interface and Routing configuration to be done on the router (LAB – 3 and 4)

### TASK:

- Verify services and communication between computers / networks before configuring the extended access list.
- Configure and implement Extended ACL - Numbered
- Verify blocked services and communication between computers / networks specified in ACL

**Verify services and communication between computers / networks before configuring the****Extended Access List****From 192.168.202.10 Computer in HYD-1 Network****ping 192.168.201.10**

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.  
64 bytes from 192.168.201.10: icmp\_seq=1 ttl=62 time=24.2 ms  
64 bytes from 192.168.201.10: icmp\_seq=2 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp\_seq=3 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp\_seq=4 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp\_seq=5 ttl=62 time=24.1 ms

**ping 192.168.203.10**

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
64 bytes from 192.168.203.10: icmp\_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp\_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.203.10: icmp\_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.203.10: icmp\_seq=29 ttl=62 time=24.2 ms

**Try to access FTP Server via browser (i.e. ftp://192.168.203.10)**

You should be able to see files on ftp server, indicates ftp service is allowed.

**Repeat the above verification from 192.168.202.20 Computer in HYD-1 Network and verify the outputs**



## Configure and Implement Extended ACL - Numbered

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ip access-list extended cisco**

HYD-1(config-ext-nacl) # **permit tcp 192.168.202.10 0.0.0.0 192.168.201.10 0.0.0.0 eq ftp**

HYD-1(config-ext-nacl) # **exit**

HYD-1 (config) #

HYD-1 (config) # **interface FastEthernet 0/0**

HYD-1 (config-if) # **ip access-group cisco in**

HYD-1 (config-if) # **exit**

### HYD-1 – Verification:

### HYD-1 – Verification:

HYD-1 # **show ip access-lists**

Extended IP access list cisco

10 deny tcp host 192.168.202.10 0.255.255.255 host 192.168.203.10 eq ftp (2 matches)

HYD-1#

HYD-1 # **show ip interface FastEthernet 0/0**

FastEthernet0/0 is up, line protocol is up

Internet address is 192.168.202.1/24

Broadcast address is 255.255.255.255

Address determined by setup command

MTU is 1500 bytes

Helper address is not set

Directed broadcast forwarding is disabled

Multicast reserved groups joined: 224.0.0.5 224.0.0.6

Outgoing access list is not set

Inbound access list is cisco

Proxy ARP is enabled

Local Proxy ARP is disabled

Security level is default

Split horizon is enabled

!

<output omitted>

!

WCCP Redirect outbound is disabled

WCCP Redirect inbound is disabled

WCCP Redirect exclude is disabled

HYD-1#

## **Verify blocked services and communication between computers / networks specified in ACL**

### **From 192.168.202.10 Computer in HYD-1 Network**

#### **ping 192.168.201.10**

```
PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.  
From 192.168.202.1 icmp_seq=1 Packet filtered  
From 192.168.202.1 icmp_seq=2 Packet filtered  
From 192.168.202.1 icmp_seq=3 Packet filtered  
From 192.168.202.1 icmp_seq=4 Packet filtered  
From 192.168.202.1 icmp_seq=5 Packet filtered
```

#### **ping 192.168.203.10**

```
PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
From 192.168.202.1 icmp_seq=1 Packet filtered  
From 192.168.202.1 icmp_seq=2 Packet filtered  
From 192.168.202.1 icmp_seq=3 Packet filtered  
From 192.168.202.1 icmp_seq=4 Packet filtered  
From 192.168.202.1 icmp_seq=5 Packet filtered
```

#### **Try to access FTP Server via browser (i.e. ftp://192.168.203.10)**

You should be able to see files on ftp server, indicates ftp service is allowed.

**Repeat the above verification from 192.168.202.20 Computer in HYD-1 Network and verify the outputs**



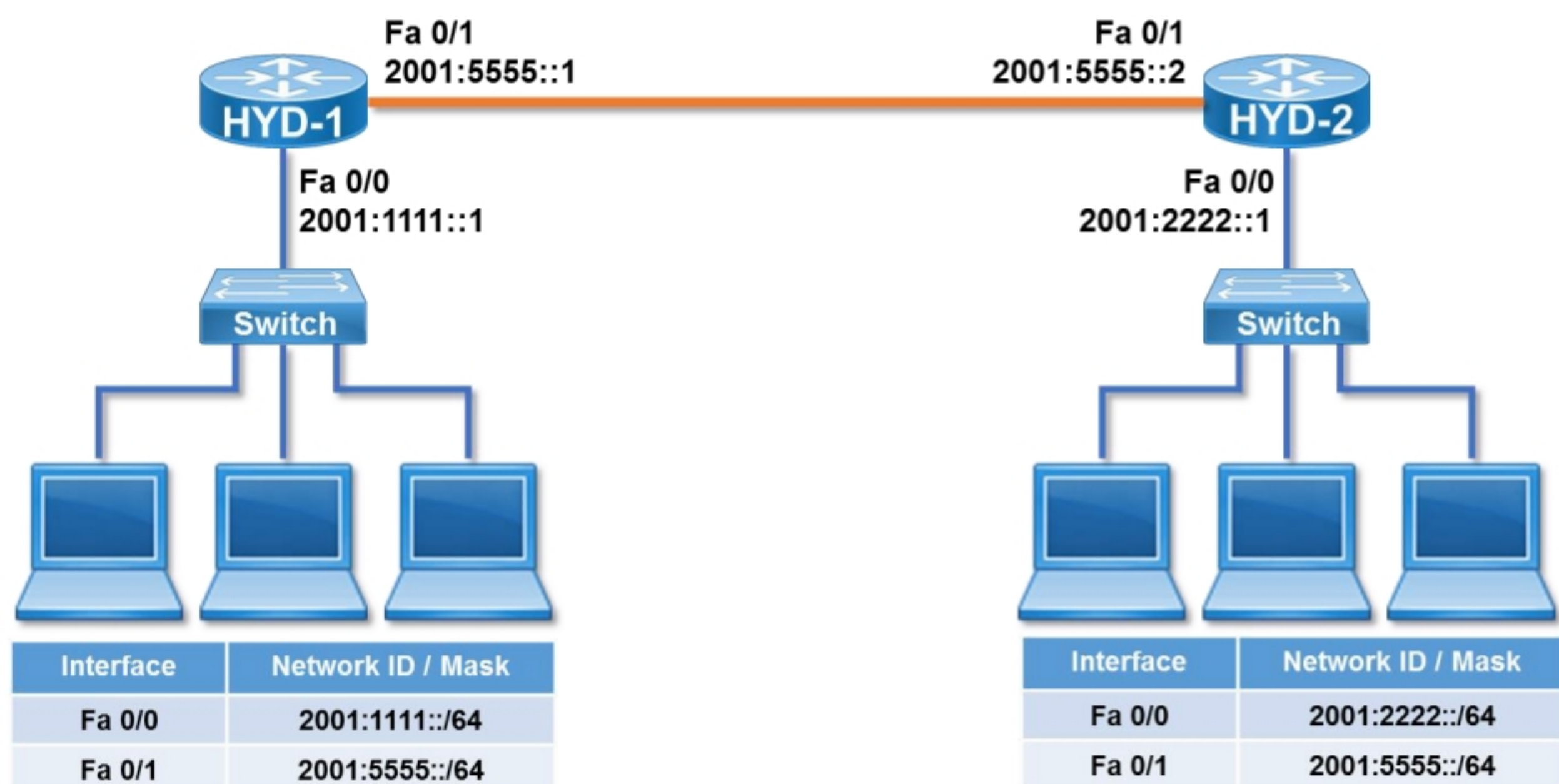
## LAB 34: ACCESS CONTROL LIST ON IPv6 NETWORK

### OBJECTIVE:

Deny HYD-1 Network - PC (i.e. 2001:1111::10/64) from accessing HTTP server (i.e. 2001:2222::10/64) in HYD-2 Network.

### TOPOLOGY:

Configure Ethernet IP addresses for the lab as below :



**Pre-requisite:** WAN Interface and Routing configuration to be done on the router (LAB – 3 and 4)

### TASK:

- Verify communication between computers / networks before configuring the access list
- Configure and implement IPv6 ACL
- Verify blocked communication between computers / networks specified in ACL

**Verify communication between computers / networks before configuring the access list**

**From 2001:1111::10 Computer in HYD-1 Network**

**ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)**

```
PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=62 time=0.336 ms
```

**Try to access HTTP Server via browser (i.e. <http://2001:2222::10>)**

You should be able to see Test web page, indicates http service is allowed.

**From 2001:1111::20 Computer in HYD-1 Network**

**ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)**

```
PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=62 time=0.336 ms
```

**Try to access HTTP Server via browser (i.e. <http://2001:2222::10>)**

You should be able to see Test web page, indicates http service is allowed.



## Configure and Implement Extended ACL - Named

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ipv6 access-list cisco**

HYD-1 (config-ipv6-acl) # **deny tcp 2001:1111::10/64 2001:2222::10/64 eq 80**

HYD-1 (config-ipv6-acl) # **permit ipv6 any any**

HYD-1(config-ipv6-acl) # **exit**

HYD-1 (config) #

HYD-1 (config) # **interface FastEthernet 0/0**

HYD-1 (config-if) # **ipv6 traffic-filter cisco in**

HYD-1 (config-if) # **exit**

HYD-1 (config)#

### HYD-1 – Verification:

HYD-1 # **show ipv6 access-list**

IPv6 access list cisco

deny tcp 2001:1111::/64 2001:2222::/64 eq www sequence 10

permit ipv6 any any (22 matches) sequence 20

HYD-1#

## Verify blocked communication between computers / networks specified in ACL

### From 2001:1111::10 Computer in HYD-1 Network

**ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)**

```
From 2001:1111::1 icmp_seq=1 Packet filtered
From 2001:1111::1 icmp_seq=2 Packet filtered
From 2001:1111::1 icmp_seq=3 Packet filtered
From 2001:1111::1 icmp_seq=4 Packet filtered
From 2001:1111::1 icmp_seq=5 Packet filtered
```

**Try to access HTTP Server via browser (i.e. <http://2001:2222::10>)**

You should not be able to see Test web page, indicates http service is blocked.

### From 2001:1111::20 Computer in HYD-1 Network

**ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)**

```
PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=62 time=0.336 ms
```

**Try to access HTTP Server via browser (i.e. <http://2001:2222::10>)**

You should be able to see Test web page, indicates http service is allowed.



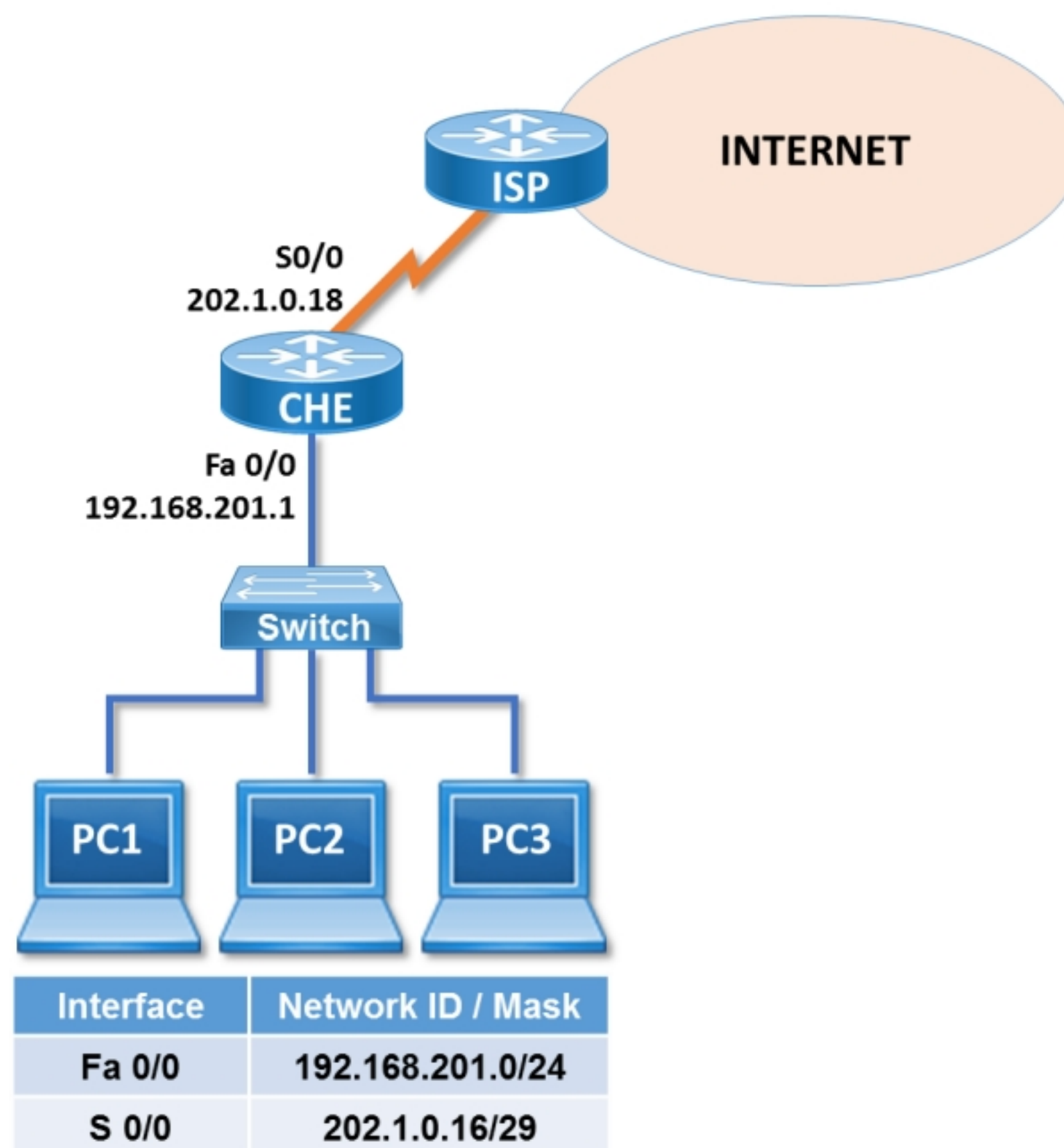
## LAB 35: DEFAULT ROUTING

### OBJECTIVE:

To configure default routing for accessing Internet.

### TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



### TASK:

- Configure WAN Interface
- Configure Default Routing
- Verify Default Routing
- Verify communication from LAN to the Internet

## Configure WAN Interface

Configure WAN Interface IP address according to topology diagram (i.e. IP addresses provided by ISP)

### CHE – Configuration

CHE # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

CHE (config)# **interface serial 0/0**

CHE (config-if)# **ip address 202.1.0.18 255.255.255.248**

CHE (config-if)# **no shutdown**

CHE (config-if)# **encapsulation ppp**

CHE (config-if)# **exit**

CHE (config)#

## Configure Default Routing

### CHE – Configuration

CHE # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

CHE (config) # **ip route 0.0.0.0 0.0.0.0 Serial0/0**

CHE (config) # **exit**

CHE (config) #

## Verify Default Routing

Once Default routing is configured IP Network defined through the **default routing command** is added into the routing information table. "\*" represents **Default route**.

### CHE – Verification:

CHE # **show ip route**

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area

\* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is not set

C 202.1.0.16/29 is directly connected, Serial0/0

C 192.168.201.0/24 is directly connected, FastEthernet0/0

S\* 0.0.0.0/0 [1/0] via Serial0/0

CHE #



**Verify communication from LAN to the Internet.****Verification from PC1**

**ping 8.8.8.8**

PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.

64 bytes from 8.8.8.8: icmp\_seq=1 ttl=62 time=24.0 ms

64 bytes from 8.8.8.8: icmp\_seq=2 ttl=62 time=24.0 ms

64 bytes from 8.8.8.8: icmp\_seq=3 ttl=62 time=24.1 ms

64 bytes from 8.8.8.8: icmp\_seq=4 ttl=62 time=24.0 ms

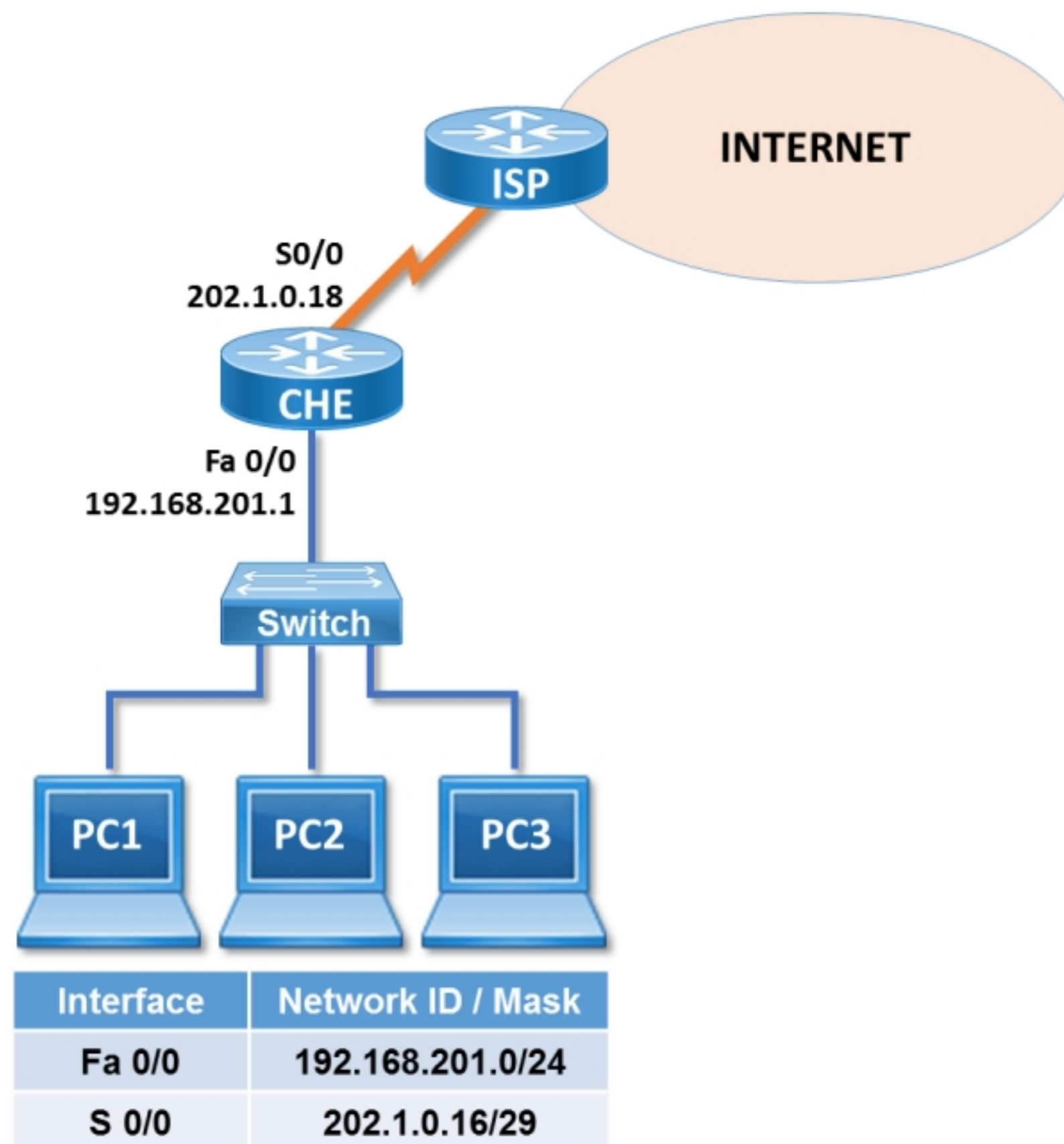
## LAB 36: STATIC NAT

### OBJECTIVE:

To configure Static NAT for Hosting Public Servers on the Internet.

### TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



**Pre-requisite:** Default Routing configuration to be done on the router (LAB – 31)

### TASK:

- Configure Static NAT
- Verify Static NAT
- Verify Static NAT Packets
- Verify communication from Internet to Server



## Configure Static NAT

```
CHE (config) # interface serial 0/0
CHE (config-if) # ip nat outside
CHE (config-if) # exit
CHE (config) # interface FastEthernet 0/0
CHE (config-if) # ip nat inside
CHE (config-if) # exit
CHE (config)# ip nat inside source static 192.168.201.10 202.1.0.19
```

## Verify Static NAT

### CHE – Verification

```
CHE # show ip nat translation
```

| Pro | Inside global | Inside local   | Outside local | Outside global |
|-----|---------------|----------------|---------------|----------------|
| --- | 202.1.0.19    | 192.168.201.10 | ---           | ---            |

```
CHE #
```

```
CHE # show ip nat statistics
```

```
Total active translations: 1 (1 static, 0 dynamic; 0 extended)
```

```
Outside interfaces:
```

```
Serial0/0
```

```
Inside interfaces:
```

```
FastEthernet0/0
```

```
Hits: 0 Misses: 0
```

```
Expired translations: 0
```

```
Dynamic mappings:
```

```
CHE#
```

## Verify Static NAT Packets

Verify Static NAT Packets by enabling debug commands

```
CHE # debug ip nat
```

```
IP NAT debugging is on
```

```
CHE # terminal monitor
```

```
CHE #
```

```
00:16:38: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22575]
```

```
00:16:38: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4074]
```

```
00:16:39: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22576]
```

```
00:16:39: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4075]
```

```
00:16:40: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22577]
```

```
00:16:40: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4076]
```

```
00:16:41: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22578]
```

```
00:16:41: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4077]
```

```
CHE #
```

## Verification from Outside PC (Internet PC) to LAN (Server)

```
ping 202.1.0.19
```

```
PING 202.1.0.19 (202.1.0.19) 56(84) bytes of data.
```

```
64 bytes from 202.1.0.19: icmp_seq=1 ttl=62 time=24.0 ms
```

```
64 bytes from 202.1.0.19: icmp_seq=2 ttl=62 time=24.0 ms
```

```
64 bytes from 202.1.0.19: icmp_seq=3 ttl=62 time=24.1 ms
```

```
64 bytes from 202.1.0.19: icmp_seq=4 ttl=62 time=24.0 ms
```



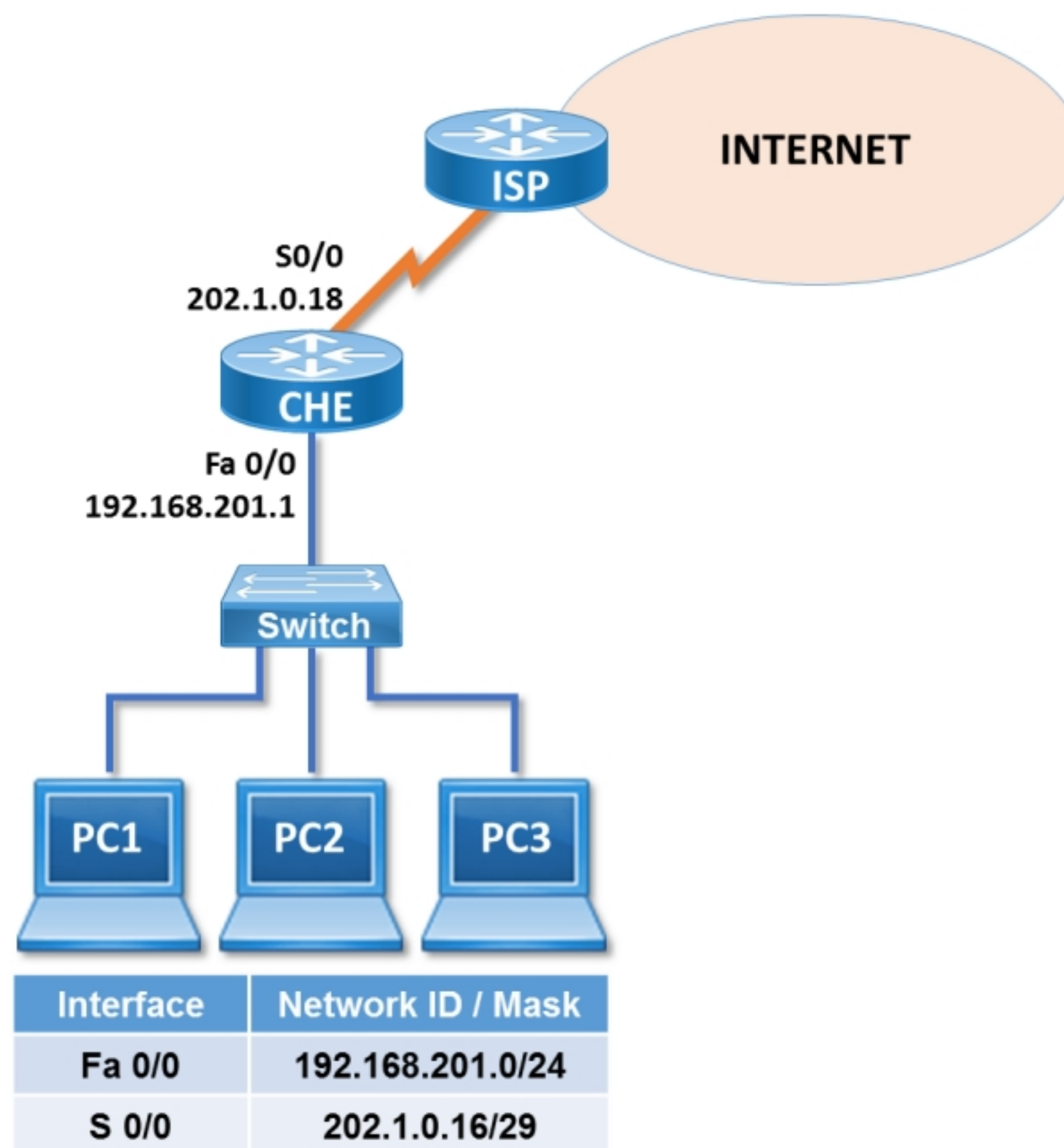
## LAB 37: PORT ADDRESS TRANSLATION (PAT)

### OBJECTIVE:

To configure PAT for LAN computers to access the Internet using a single Public IP Address.

### TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



**Pre-requisite:** Default Routing configuration to be done on the router (LAB – 31)

### TASK:

- Configure PAT
- Verify PAT
- Verify PAT Packets
- Verify communication from LAN to the Internet

## Configure PAT

```
CHE (config) # interface serial 0/0
CHE (config-if) # ip nat outside
CHE (config-if) # exit
CHE (config) # interface FastEthernet 0/0
CHE (config-if) # ip nat inside
CHE (config-if) # exit
CHE (config) # access-list 10 permit 192.168.201.0 0.0.0.255
CHE (config) # ip nat inside source list 10 interface serial 0/0 overload
```

## Verify PAT

### CHE – Verification

CHE # show ip nat translation

| Pro  | Inside global    | Inside local         | Outside local    | Outside global   |
|------|------------------|----------------------|------------------|------------------|
| icmp | 202.1.0.18:34071 | 192.168.201.10:34071 | 202.2.0.17:34071 | 202.2.0.17:34071 |
| tcp  | 202.1.0.18:49237 | 192.168.201.10:49237 | 202.2.0.17:80    | 202.2.0.17:80    |

CHE #

CHE # show ip nat statistics

Total active translations: 10 (0 static, 1 dynamic; 0 extended)

Outside interfaces:

Serial0/0

Inside interfaces:

FastEthernet0/0

Hits: 20 Misses: 0

Expired translations: 0

Dynamic mappings:

— Inside Source --

[Id: 3] access-list 10 interface Serial0/0

CHE#



## Verify PAT Packets

Verify PAT Packets by enabling debug commands

```
CHE # debug ip nat
```

```
IP NAT debugging is on
```

```
CHE # terminal monitor
```

```
CHE #
```

```
00:16:38: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22575]
```

```
00:16:38: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4074]
```

```
00:16:39: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22576]
```

```
00:16:39: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4075]
```

```
00:16:40: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22577]
```

```
00:16:40: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4076]
```

```
00:16:41: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22578]
```

```
00:16:41: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4077]
```

```
CHE #
```

## Verify communication from LAN to the Internet.

### Verification from PC1

```
ping 8.8.8.8
```

```
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
```

```
64 bytes from 8.8.8.8: icmp_seq=1 ttl=62 time=24.0 ms
```

```
64 bytes from 8.8.8.8: icmp_seq=2 ttl=62 time=24.0 ms
```

```
64 bytes from 8.8.8.8: icmp_seq=3 ttl=62 time=24.1 ms
```

```
64 bytes from 8.8.8.8: icmp_seq=4 ttl=62 time=24.0 ms
```

## LAB 38: Hot Standby Router Protocol (HSRP)

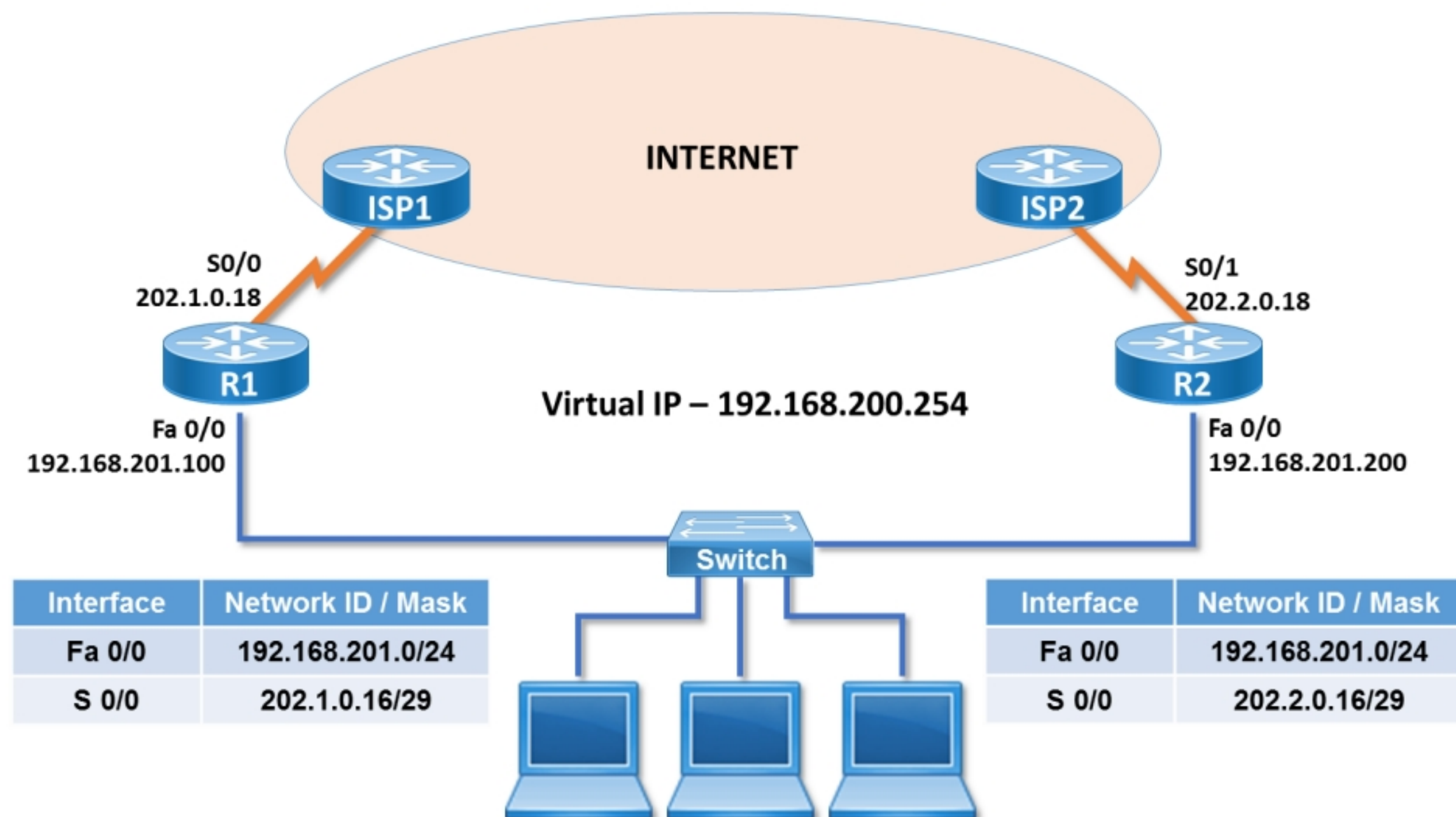
### OBJECTIVE:

To set up an always available gateway by configuring HSRP

To set up a virtual default gateway with IP 192.168.201.254 for setting up HSRP

### TOPOLOGY:

Setup Serial and Ethernet connectivity for the lab as below:



- Configure Ethernet Interface, Serial Interface and Default Routing
- Configure HSRP
- Verify HSRP
- Verify communication and data path to destination network



## **Configure Ethernet Interface, Serial Interface and Default Routing**

### **R1 – Configuration**

```
R1 (config) # interface fastethernet 0/0
R1 (config-if) # ip address 192.168.201.100 255.255.255.0
R1 (config-if) # exit
R1 (config) # interface serial 0/0
R1 (config-if) # ip address 202.1.0.18 255.255.255.248
R1 (config-if) # no shutdown
R1 (config-if) # encapsulation ppp
R1 (config-if) # exit
R1 (config) # ip route 0.0.0.0 0.0.0.0 Serial0/0
R1 (config) # exit
```

### **R2 – Configuration**

```
R2 (config) # interface fastethernet 0/0
R2 (config-if) # ip address 192.168.201.100 255.255.255.0
R2 (config-if) # exit
R2 (config) # interface serial 0/0
R2 (config-if) # ip address 202.2.0.18 255.255.255.248
R2 (config-if) # no shutdown
R2 (config-if) # encapsulation ppp
R2 (config-if) # exit
R2 (config) # ip route 0.0.0.0 0.0.0.0 Serial0/1
R2 (config) # exit
```

## **Configure HSRP**

### **R1 – Configuration**

```
R1 # configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1 (config) # int FastEthernet 0/0
R1 (config-if) # standby 10 ip 192.168.201.254
R1 (config-if) # standby 10 priority 200
R1 (config-if) # end
R1 #
```

### **R2 – Configuration**

```
R1 # configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2 (config) # int FastEthernet 0/0
R2 (config-if) # standby 10 ip 192.168.201.254
R2 (config-if) # standby 10 priority 150
R2 (config-if) # end
R2 #
```

## Verify HSRP

### R1 – Verification

R1 # **show standby**

FastEthernet0/0 - Group 10

State is Active

2 state changes, last state change 00:03:21

Virtual IP address is 192.168.201.254

Active virtual MAC address is 0000.0c07.ac0a

Local virtual MAC address is 0000.0c07.ac0a (v1 default)

Hello time 3 sec, hold time 10 sec

Next hello sent in 2.792 secs

Preemption disabled

Active router is local

Standby router is 192.168.201.200, priority 150 (expires in 7.848 sec)

Priority 200 (configured 200)

IP redundancy name is "hsrp-Fa0/0-10" (default)

R1#

### R2 – Verification

R2 # **show standby**

FastEthernet0/0 - Group 10

State is Standby

1 state change, last state change 00:01:09

Virtual IP address is 192.168.201.254

Active virtual MAC address is 0000.0c07.ac0a

Local virtual MAC address is 0000.0c07.ac0a (v1 default)

Hello time 3 sec, hold time 10 sec

Next hello sent in 2.860 secs

Preemption disabled

Active router is 192.168.201.100, priority 200 (expires in 8.802 sec)

Standby router is local

Priority 150 (configured 150)

IP redundancy name is "hsrp-Fa0/0-10" (default)

R2 #

## Verify communication and data path to destination network

### Verification from a Computer in Network

**ping 8.8.8.8**

PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.

64 bytes from 8.8.8.8: icmp\_seq=25 ttl=62 time=24.1 ms

64 bytes from 8.8.8.8: icmp\_seq=26 ttl=62 time=24.1 ms

64 bytes from 8.8.8.8: icmp\_seq=27 ttl=62 time=24.3 ms

64 bytes from 8.8.8.8: icmp\_seq=28 ttl=62 time=24.2 ms

64 bytes from 8.8.8.8: icmp\_seq=29 ttl=62 time=24.2 ms



## From a Computer in Network trace communication path to destination network

```
tracert 8.8.8.8 (Windows) or traceroute 8.8.8.8 (Linux)
traceroute to 8.8.8.8 (192.168.203.10), 30 hops max, 38 byte packets
 1  192.168.201.100 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2  8.8.8.8 (8.8.8.8)  2.295 ms  2.156 ms  2.209 ms
```

## Understand HSRP behaviour

Currently data is flowing via **R1** router, if **R1** router goes down data will start flowing through **R2** router.

You can verify the behaviour by shutting down **R1** Router Ethernet Interface (LAN Interface) or remove the Ethernet cable from R1 Router and check the behaviour.

## Verify HSRP

### R1 – Verification

```
R1 # show standby
FastEthernet0/0 - Group 10
  State is Standby
    2 state changes, last state change 00:03:21
  Virtual IP address is 192.168.201.250
  Active virtual MAC address is 0000.0c07.ac0a
    Local virtual MAC address is 0000.0c07.ac0a (v1 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.792 secs
  Preemption disabled
  Active router is 192.168.201.200, priority 150 (expires in 8.802 sec)
  Standby router is local
  Priority 200 (configured 200)
  IP redundancy name is "hsrp-Fa0/0-10" (default)
R1#
```

### R2 – Verification

```
R2 # show standby
FastEthernet0/0 - Group 10
  State is Active
    1 state change, last state change 00:01:09
  Virtual IP address is 192.168.201.250
  Active virtual MAC address is 0000.0c07.ac0a
    Local virtual MAC address is 0000.0c07.ac0a (v1 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.860 secs
  Preemption disabled
  Active router is local
  Standby router is 192.168.201.100, priority 200 (expires in 7.848 sec)
  Priority 150 (configured 150)
  IP redundancy name is "hsrp-Fa0/0-10" (default)
R2 #
```

## Verify communication and data path to destination network

### Verification from a Computer in Network

**ping 8.8.8.8**

PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.

64 bytes from 8.8.8.8: icmp\_seq=25 ttl=62 time=24.1 ms

64 bytes from 8.8.8.8: icmp\_seq=26 ttl=62 time=24.1 ms

64 bytes from 8.8.8.8: icmp\_seq=27 ttl=62 time=24.3 ms

64 bytes from 8.8.8.8: icmp\_seq=28 ttl=62 time=24.2 ms

64 bytes from 8.8.8.8: icmp\_seq=29 ttl=62 time=24.2 ms

### From a Computer in Network trace communication path to destination network

**tracert 8.8.8.8 (Windows) or traceroute 8.8.8.8 (Linux)**

traceroute to 8.8.8.8 (8.8.8.8), 30 hops max, 38 byte packets

1 192.168.201.200 (192.168.201.200) 1.086 ms 1.124 ms 1.144 ms

2 8.8.8.8 (8.8.8.8) 2.295 ms 2.156 ms 2.209 ms



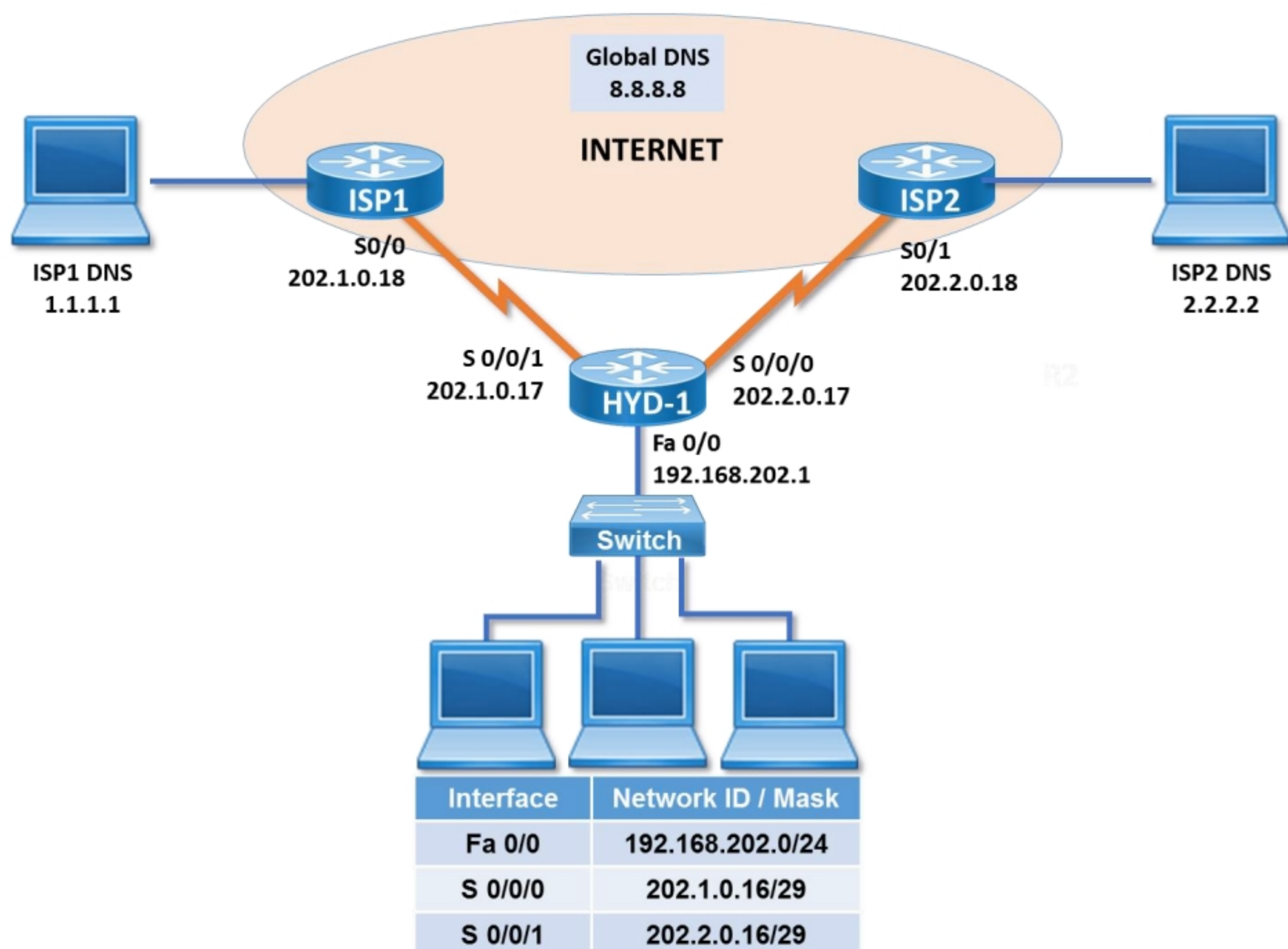
## LAB 39: IP SLA

### OBJECTIVE:

To configure IP SLA feature to monitor ISP link failure and injecting another default route for backup ISP

### TOPOLOGY:

Setup Serial and Ethernet connectivity for the lab as below:



- Configure Serial Interface and Default Routing
- Configure IP SLA
- Verify IP SLA
- Verify communication and data path to destination network

## Configure Serial Interface and Default Routing

### HYD-1 – Configuration

```
HYD-1 (config) # interface serial 0/0/0
HYD-1 (config-if) # ip address 202.2.0.17 255.255.255.248
HYD-1 (config-if) # no shutdown
HYD-1 (config-if) # encapsulation ppp
HYD-1 (config-if) # exit
HYD-1 (config) # interface serial 0/0/1
HYD-1 (config-if) # ip address 202.1.0.17 255.255.255.248
HYD-1 (config-if) # no shutdown
HYD-1 (config-if) # encapsulation ppp
HYD-1 (config-if) # exit
HYD-1 (config) # ip route 0.0.0.0 0.0.0.0 202.1.0.18
HYD-1 (config) # ip route 0.0.0.0 0.0.0.0 202.2.0.18 2
HYD-1 (config) # exit
HYD-1 #
```

## Configure IP SLA

### HYD-1 – Configuration

#### **R1 # configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

```
HYD-1 (config) # ip sla 1
HYD-1 (config-ip-sla) # icmp-echo 1.1.1.1
HYD-1 (config-ip-sla-echo) # frequency 5
HYD-1 (config-ip-sla-echo) # exit

HYD-1 (config) # ip sla schedule 1 start-time now life forever
HYD-1 (config) # track 10 ip sla 1
HYD-1 (config-track) # delay down 20 up 10
HYD-1 (config-track) # exit
HYD-1 (config) # ip route 0.0.0.0 0.0.0.0 202.1.0.18 track 10
HYD-1 (config) # end
HYD-1 #
```



## Verify IP SLA

### HYD-1 – Verification

#### HYD-1 # **sh ip route**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
 E1 - OSPF external type 1, E2 - OSPF external type 2  
 i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
 ia - IS-IS inter area, \* - candidate default, U - per-user static route  
 o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP  
 + - replicated route, % - next hop override

Gateway of last resort is 202.1.0.18 to network 0.0.0.0

**S\*** 0.0.0.0/0 [1/0] via 202.1.0.18

192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.202.0/24 is directly connected, FastEthernet0/0

L 192.168.202.1/32 is directly connected, FastEthernet0/0

202.1.0.16/29 is variably subnetted, 2 subnets, 2 masks

C 202.1.0.16/29 is directly connected, Serial0/0/1

L 202.1.0.17/32 is directly connected, Serial0/0/1

202.2.0.16/16 is variably subnetted, 2 subnets, 2 masks

C 202.2.0.0/16 is directly connected, Serial0/0/0

L 202.2.0.17/32 is directly connected, Serial0/0/0

HYD-1 #

## Verify communication and data path to destination network

### Verification from a Computer in HYD-1 Network

**ping 8.8.8.8**

PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.

64 bytes from 8.8.8.8: icmp\_seq=25 ttl=62 time=24.1 ms

64 bytes from 8.8.8.8: icmp\_seq=26 ttl=62 time=24.1 ms

64 bytes from 8.8.8.8: icmp\_seq=27 ttl=62 time=24.3 ms

64 bytes from 8.8.8.8: icmp\_seq=28 ttl=62 time=24.2 ms

64 bytes from 8.8.8.8: icmp\_seq=29 ttl=62 time=24.2 ms

### From a Computer in HYD-1 Network trace communication path to destination network

**tracert 8.8.8.8 (Windows) or traceroute 8.8.8.8 (Linux)**

traceroute to 8.8.8.8 (8.8.8.8), 30 hops max, 38 byte packets

1 192.168.202.1 (192.168.202.1) 1.086 ms 1.124 ms 1.144 ms

2 202.1.0.18 (202.1.0.18) 1.086 ms 1.124 ms 1.144 ms

3 8.8.8.8 (8.8.8.8) 2.295 ms 2.156 ms 2.209 ms

## Understand IP SLA behaviour

Currently data is flowing via **ISP1**, if **ISP1 DNS Server** goes down or is not reachable data will start flowing through **ISP2**. You can verify the behaviour by shutting down ISP1 DNS Server.

## Verify IP SLA

### HYD-1 – Verification

#### HYD-1 # sh ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, \* - candidate default, U - per-user static route  
o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP  
+ - replicated route, % - next hop override

Gateway of last resort is 202.2.0.18 to network 0.0.0.0

S\* 0.0.0.0/0 [2/0] via 202.2.0.18

192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.202.0/24 is directly connected, FastEthernet0/0

L 192.168.202.1/32 is directly connected, FastEthernet0/0

202.1.0.16/29 is variably subnetted, 2 subnets, 2 masks

C 202.1.0.16/29 is directly connected, Serial0/0/1

L 202.1.0.17/32 is directly connected, Serial0/0/1

202.2.0.16/16 is variably subnetted, 2 subnets, 2 masks

C 202.2.0.0/16 is directly connected, Serial0/0/0

L 202.2.0.17/32 is directly connected, Serial0/0/0

HYD-1 #

## Verify communication and data path to destination network

### Verification from a Computer in HYD-1 Network

#### ping 8.8.8.8

PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.

64 bytes from 8.8.8.8: icmp\_seq=25 ttl=62 time=24.1 ms

64 bytes from 8.8.8.8: icmp\_seq=26 ttl=62 time=24.1 ms

64 bytes from 8.8.8.8: icmp\_seq=27 ttl=62 time=24.3 ms

64 bytes from 8.8.8.8: icmp\_seq=28 ttl=62 time=24.2 ms

64 bytes from 8.8.8.8: icmp\_seq=29 ttl=62 time=24.2 ms



**From a Computer in HYD-1 Network trace communication path to destination network**

**tracert 8.8.8.8 (Windows) or traceroute 8.8.8.8 (Linux)**

traceroute to 8.8.8.8 (8.8.8.8), 30 hops max, 38 byte packets

|   |                               |          |          |          |
|---|-------------------------------|----------|----------|----------|
| 1 | 192.168.202.1 (192.168.202.1) | 1.086 ms | 1.124 ms | 1.144 ms |
| 2 | 202.2.0.18 (202.2.0.18)       | 1.086 ms | 1.124 ms | 1.144 ms |
| 3 | 8.8.8.8 (8.8.8.8)             | 2.295 ms | 2.156 ms | 2.209 ms |

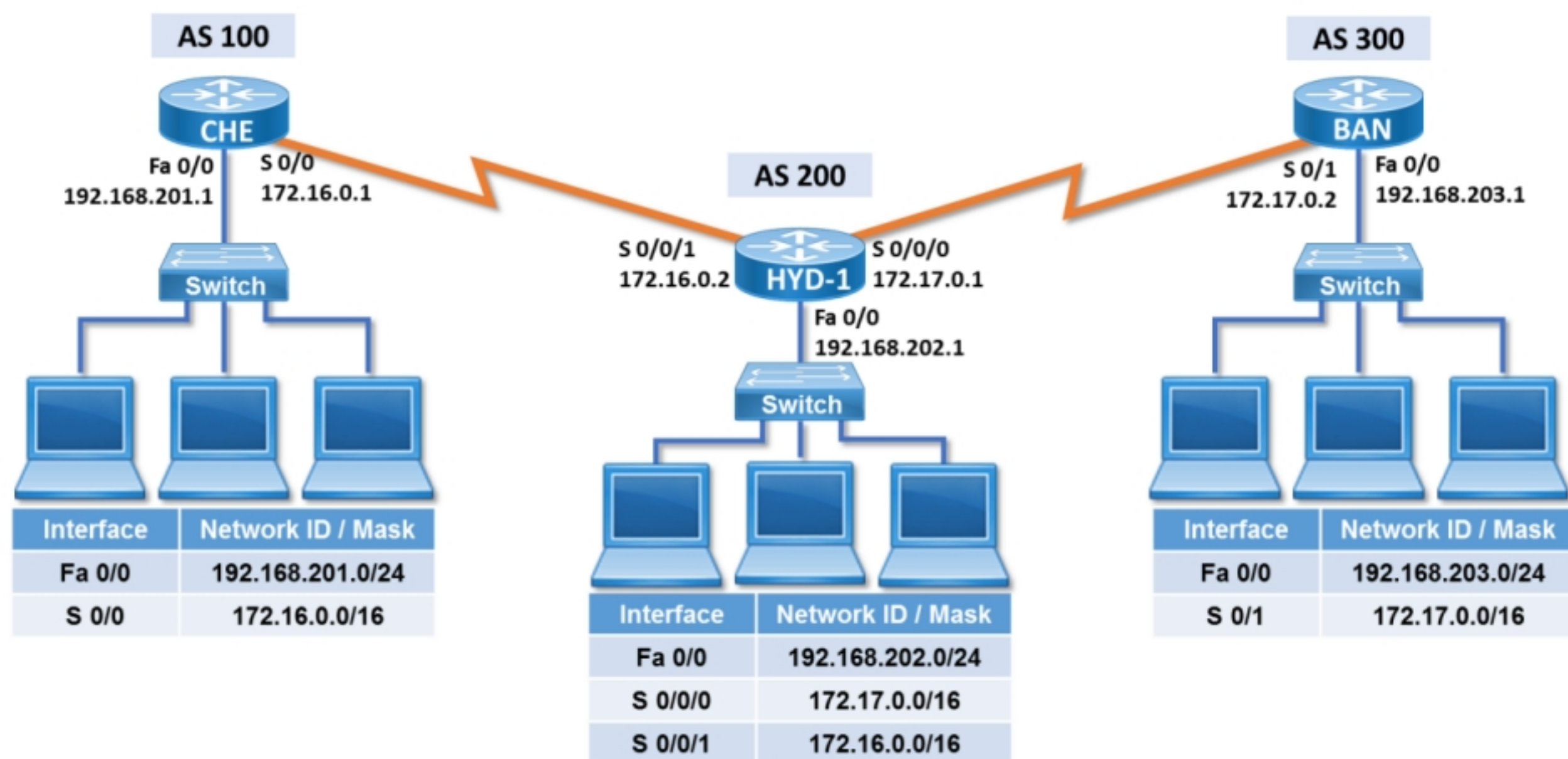
## LAB 40: BGP ON IPv4 network

### OBJECTIVE:

To configure BGP for communicating between different IPv4 networks in different Autonomous system.

### TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



**Pre-requisite: WAN Interface configuration to be done on the router (LAB – 6)**

### TASK:

- Configure BGP Routing on IPv4 network
- Verify BGP Routing on IPv4 network
- Verify Communication between the IPv4 networks
- Verify BGP Neighbour and Topology Table on IPv4 networks
- Verify BGP Neighbour Detail



## Configure BGP Routing on IPv4 network

### CHE – Configuration

#### **CHE # configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

CHE (config) # **ip routing**

CHE (config) # **router bgp 100**

CHE (config-router) # **network 192.168.201.0 mask 255.255.255.0**

CHE (config-router) # **network 172.16.0.0 mask 255.255.0.0**

CHE (config-router) # **neighbor 172.16.0.2 remote-as 200**

CHE (config-router) # **end**

CHE #

### HYD-1 – Configuration

#### **HYD-1 # configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ip routing**

HYD-1 (config) # **router bgp 200**

HYD-1 (config-router) # **network 192.168.202.0 mask 255.255.255.0**

HYD-1 (config-router) # **network 172.16.0.0 mask 255.255.0.0**

HYD-1 (config-router) # **network 172.17.0.0 mask 255.255.0.0**

HYD-1 (config-router) # **neighbor 172.16.0.1 remote-as 100**

HYD-1 (config-router) # **neighbor 172.17.0.2 remote-as 300**

HYD-1 (config-router) # **end**

HYD-1 #

### BAN – Configuration

#### **BAN # configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

BAN (config) # **ip routing**

BAN (config) # **router bgp 300**

BAN (config-router) # **network 192.168.203.0 mask 255.255.255.0**

BAN (config-router) # **network 172.17.0.0 mask 255.255.0.0**

BAN (config-router) # **neighbor 172.17.0.1 remote-as 200**

BAN (config-router) # **end**

BAN (config) #

## Verify BGP Routing

Once BGP routing is enabled, IPv4 Networks learnt via **BGP** are added into the routing table. “**B**” represents **BGP route**.

### CHE – Verification:

#### CHE # show ip route

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
 i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area  
 \* - candidate default, U - per-user static route, o - ODR  
 P - periodic downloaded static route

Gateway of last resort is not set

```
B 172.17.0.0/16 [20/0] via 172.16.0.2, 00:04:02
C 172.16.0.0/16 is directly connected, Serial0/0
C 192.168.201.0/24 is directly connected, FastEthernet0/0
B 192.168.202.0/24 [20/0] via 172.16.0.2, 00:00:03
B 192.168.203.0/24 [20/0] via 172.16.0.2, 00:02:46
CHE #
```

### HYD-1 – Verification:

#### HYD-1 # show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 E1 - OSPF external type 1, E2 - OSPF external type 2  
 ia - IS-IS inter area, \* - candidate default, U - per-user static route  
 o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP  
 + - replicated route, % - next hop override

Gateway of last resort is not set

```
172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.16.0.0/16 is directly connected, Serial0/0/1
L 172.16.0.2/32 is directly connected, Serial0/0/1
172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.17.0.0/16 is directly connected, Serial0/0/0
L 172.17.0.1/32 is directly connected, Serial0/0/0
B 192.168.201.0/24 [20/0] via 172.16.0.1, 00:04:15
192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.202.0/24 is directly connected, FastEthernet0/0
L 192.168.202.1/32 is directly connected, FastEthernet0/0
B 192.168.203.0/24 [20/0] via 172.17.0.2, 00:03:00
HYD-1#
```



**BAN – Verification:****BAN # show ip route**

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, \* - candidate default, U - per-user static route  
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

```
C 172.17.0.0/16 is directly connected, Serial0/1
B 172.16.0.0/16 [20/0] via 172.17.0.1, 00:03:23
B 192.168.201.0/24 [20/0] via 172.17.0.1, 00:03:23
B 192.168.202.0/24 [20/0] via 172.17.0.1, 00:00:11
C 192.168.203.0/24 is directly connected, FastEthernet0/0
BAN#
```

**Verify communication between the IPv4 networks****Verification from a Computer in HYD-1 Network****ping 192.168.201.10**

```
PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=4 ttl=62 time=24.0 ms
```

**ping 192.168.203.10**

```
PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms
```

**Repeat the above ping verification from a computer in CHE and BAN Network.**

### From a Computer in HYD-1 Network trace communication path to a Computer in CHE Network

```
tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)
traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets
 1  192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2  172.16.0.1 (172.16.0.1)  2.295 ms  2.156 ms  2.209 ms
 3  192.168.201.10 (192.168.202.10)  3.295 ms  3.156 ms  3.209 ms
```

### From a Computer in HYD-1 Network trace communication path to a Computer in BAN Network

```
tracert 192.168.203.10 (Windows) or traceroute 192.168.203.10 (Linux)
traceroute to 192.168.203.10 (192.168.203.10), 30 hops max, 38 byte packets
 1  192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2  172.17.0.2 (172.17.0.2)  2.295 ms  2.156 ms  2.209 ms
 3  192.168.203.10 (192.168.203.10)  3.295 ms  3.156 ms  3.209 ms
```

**Repeat the above trace communication path from a computer in CHE and BAN Network.**

### Verify BGP Neighbour and BGP Table on IPv4 Network

#### CHE – Verification:

**CHE # show ip bgp summary**

```
BGP router identifier 192.168.201.1, local AS number 100
BGP table version is 6, main routing table version 6
5 network entries and 6 paths using 701 bytes of memory
3 BGP path attribute entries using 180 bytes of memory
2 BGP AS-PATH entries using 48 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP activity 5/0 prefixes, 6/0 paths, scan interval 60 secs
```

| Neighbor   | V | AS  | MsgRcvd | MsgSent | TblVer | InQ | OutQ | Up/Down  | State/PfxRcd |
|------------|---|-----|---------|---------|--------|-----|------|----------|--------------|
| 172.16.0.2 | 4 | 200 | 15      | 12      | 6      | 0   | 0    | 00:07:40 | 4            |

CHE#

**CHE # show ip bgp**

```
BGP table version is 6, local router ID is 192.168.201.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal
Origin codes: i - IGP, e - EGP, ? - incomplete
```

|    | Network       | Next Hop   | Metric | LocPrf | Weight | Path      |
|----|---------------|------------|--------|--------|--------|-----------|
| *  | 172.16.0.0    | 172.16.0.2 | 0      |        | 0      | 200 i     |
| *> |               | 0.0.0.0    | 0      |        | 32768  | i         |
| *> | 172.17.0.0    | 172.16.0.2 | 0      |        | 0      | 200 i     |
| *> | 192.168.201.0 | 0.0.0.0    | 0      |        | 32768  | i         |
| *> | 192.168.202.0 | 172.16.0.2 | 0      |        | 0      | 200 i     |
| *> | 192.168.203.0 | 172.16.0.2 | 0      |        | 0      | 200 300 i |

CHE#



### HYD-1 – Verification:

#### HYD-1 # show ip bgp summary

```
BGP router identifier 192.168.202.1, local AS number 200
BGP table version is 6, main routing table version 6
5 network entries using 680 bytes of memory
7 path entries using 392 bytes of memory
3/3 BGP path/bestpath attribute entries using 384 bytes of memory
2 BGP AS-PATH entries using 48 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP using 1504 total bytes of memory
BGP activity 5/0 prefixes, 7/0 paths, scan interval 60 secs
```

| Neighbor   | V | AS  | MsgRcvd | MsgSent | TblVer | InQ | OutQ | Up/Down  | State/PfxRcd |
|------------|---|-----|---------|---------|--------|-----|------|----------|--------------|
| 172.16.0.1 | 4 | 100 | 11      | 13      | 6      | 0   | 0    | 00:06:00 | 2            |
| 172.17.0.2 | 4 | 300 | 9       | 12      | 6      | 0   | 0    | 00:05:14 | 2            |

HYD-1#

#### HYD-1 # show ip bgp

```
BGP table version is 6, local router ID is 192.168.202.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
               r RIB-failure, S Stale, m multipath, b backup-path, x best-external, f RT-Filter
Origin codes: i - IGP, e - EGP, ? - incomplete
```

|    | Network       | Next Hop   | Metric | LocPrf | Weight | Path  |
|----|---------------|------------|--------|--------|--------|-------|
| *  | 172.16.0.0    | 172.16.0.1 | 0      |        | 0      | 100 i |
| *> |               | 0.0.0.0    | 0      |        | 32768  | i     |
| *  | 172.17.0.0    | 172.17.0.2 | 0      |        | 0      | 300 i |
| *> |               | 0.0.0.0    | 0      |        | 32768  | i     |
| *> | 192.168.201.0 | 172.16.0.1 | 0      |        | 0      | 100 i |
| *> | 192.168.202.0 | 0.0.0.0    | 0      |        | 32768  | i     |
| *> | 192.168.203.0 | 172.17.0.2 | 0      |        | 0      | 300 i |

HYD-1#

### BAN – Verification:

#### BAN # show ip bgp summary

```
BGP router identifier 192.168.203.1, local AS number 300
BGP table version is 7, main routing table version 7
5 network entries and 6 paths using 701 bytes of memory
3 BGP path attribute entries using 156 bytes of memory
2 BGP AS-PATH entries using 48 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP activity 5/0 prefixes, 6/0 paths, scan interval 15 secs
```

| Neighbor   | V | AS  | MsgRcvd | MsgSent | TblVer | InQ | OutQ | Up/Down  | State/PfxRcd |
|------------|---|-----|---------|---------|--------|-----|------|----------|--------------|
| 172.17.0.1 | 4 | 200 | 12      | 9       | 7      | 0   | 0    | 00:05:45 | 4            |

BAN#

BAN # **show ip bgp**

BGP table version is 7, local router ID is 192.168.203.1

Status codes: s suppressed, d damped, h history, \* valid, > best, i - internal

Origin codes: i - IGP, e - EGP, ? - incomplete

| Network          | Next Hop   | Metric | LocPrf | Weight | Path      |
|------------------|------------|--------|--------|--------|-----------|
| *> 172.16.0.0    | 172.17.0.1 | 0      |        | 0      | 200 i     |
| *> 172.17.0.0    | 0.0.0.0    | 0      |        | 32768  | i         |
| *                | 172.17.0.1 | 0      |        | 0      | 200 i     |
| *> 192.168.201.0 | 172.17.0.1 | 0      |        | 0      | 200 100 i |
| *> 192.168.202.0 | 172.17.0.1 | 0      |        | 0      | 200 i     |
| *> 192.168.203.0 | 0.0.0.0    | 0      |        | 32768  | i         |

BAN#

### Verify BGP Neighbor Detail

#### Example - HYD-1

HYD-1 # **show ip bgp neighbors 172.16.0.1**

show ip bgp neighbors 172.16.0.1

BGP neighbor is 172.16.0.1, remote AS 100, external link

BGP version 4, remote router ID 192.168.201.1

BGP state = Established, up for 00:08:30

Last read 00:00:30, last write 00:00:03, hold time is 180, keepalive interval is 60 seconds

Neighbor sessions:

1 active, is not multisession capable (disabled)

Neighbor capabilities:

Route refresh: advertised and received(new)

Four-octets ASN Capability: advertised

Address family IPv4 Unicast: advertised and received

Multisession Capability:

Message statistics:

InQ depth is 0

OutQ depth is 0

!

<output omitted>

!

Datagrams (max data segment is 1460 bytes):

Rcvd: 25 (out of order: 0), with data: 12, total data bytes: 309

Sent: 27 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0), with data: 15, total data bytes: 438

Packets received in fast path: 0, fast processed: 0, slow path: 0

fast lock acquisition failures: 0, slow path: 0

HYD-1 #



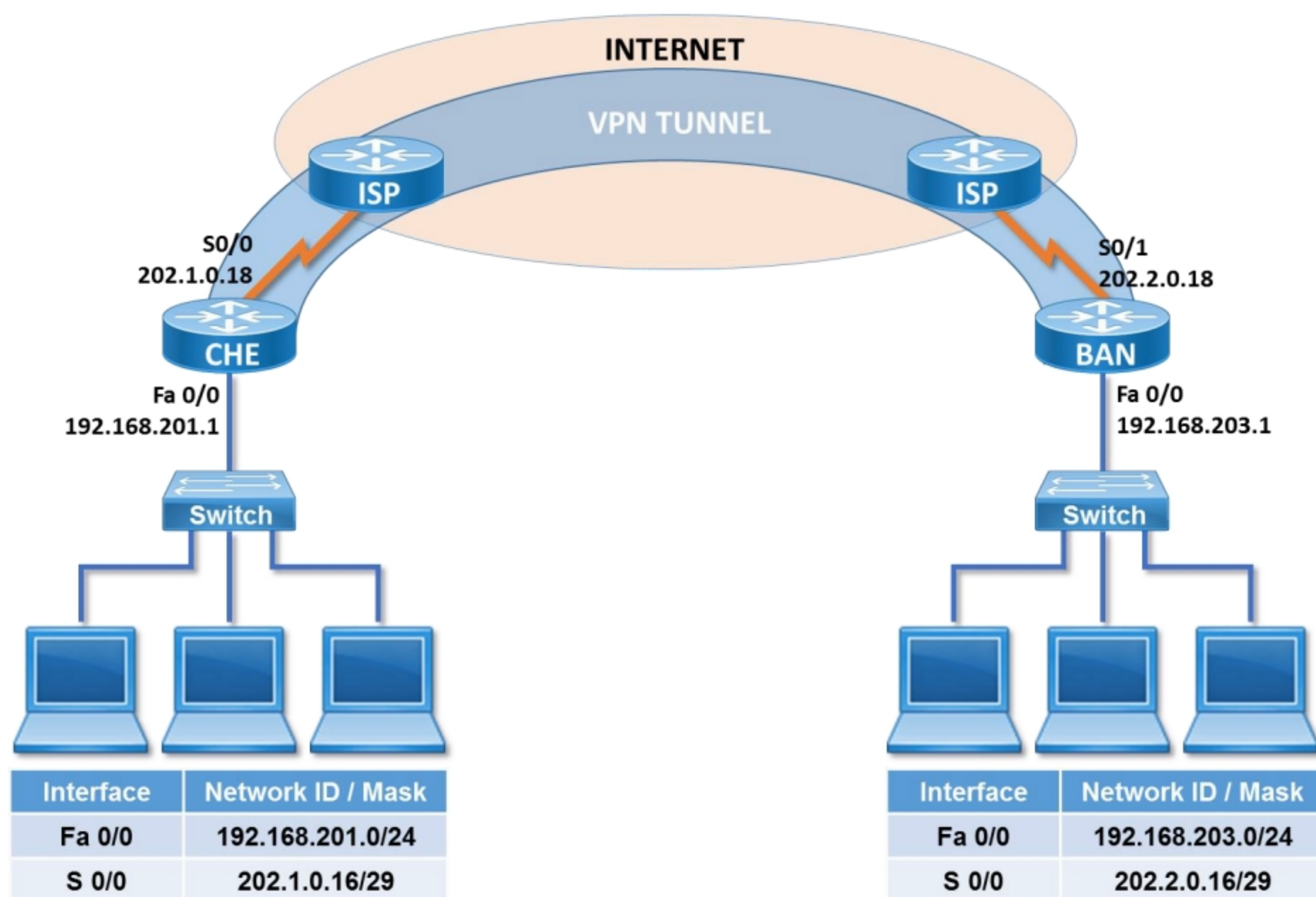
## LAB 41: GENERIC ROUTING ENCAPSULATION (GRE)

### OBJECTIVE:

To set up a GRE VPN to enable communication between different networks .

### TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



### TASK:

- Configure Serial Interface
- Configure Default Routing
- Configure GRE Tunnel Interface
- Verify GRE Tunnel Configuration
- Configure Routing
- Verify Routing
- Verify communication between the networks

## **Configure Serial Interface**

### **CHE – Configuration**

```
CHE (config) # interface serial 0/0
CHE (config-if) # ip address 202.1.0.18 255.255.255.248
CHE (config-if) # no shutdown
CHE (config-if) # encapsulation ppp
CHE (config-if) # exit
CHE (config) #
```

### **BAN – Configuration**

```
BAN (config) # interface serial 0/1
BAN (config-if) # ip address 202.2.0.18 255.255.255.248
BAN (config-if) # no shutdown
BAN (config-if) # encapsulation ppp
BAN (config-if) # exit
BAN (config) #
```

## **Configure Default Routing**

### **CHE – Configuration**

```
CHE # configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config) # ip route 0.0.0.0 0.0.0.0 Serial0/0
CHE (config) # exit
CHE #
```

### **BAN – Configuration**

```
BAN # configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
BAN (config) # ip route 0.0.0.0 0.0.0.0 Serial0/1
BAN (config) # exit
BAN #
```



## Configure GRE Tunnel Interface

### CHE – Configuration

```
CHE (config) # int tunnel 0
CHE (config-if) # ip add 1.1.1.1 255.255.255.0
CHE (config-if) # tunnel mode gre ip
CHE (config-if) # tunnel source serial 0/0
CHE (config-if) # tunnel destination 202.2.0.18
CHE (config-if) # end
CHE #
```

### BAN – Configuration

```
BAN (config) # int tunnel 0
BAN (config-if)# ip add 1.1.1.2 255.255.255.0
CHE (config-if) # tunnel mode gre ip
BAN (config-if)# tunnel source serial 0/1
BAN (config-if)# tunnel destination 202.1.0.18
BAN (config-if)# end
BAN #
```

## Verify GRE Tunnel Configuration

### CHE – Verification

```
CHE # show ip interface brief tunnel 0
```

| Interface | IP-Address | OK? | Method | Status | Protocol |
|-----------|------------|-----|--------|--------|----------|
| Tunnel0   | 1.1.1.1    | YES | manual | up     | up       |

```
CHE #
```

```
CHE # sh int tunnel 0
```

```
Tunnel0 is up, line protocol is up
```

```
Hardware is Tunnel
```

```
Internet address is 1.1.1.1/24
```

```
MTU 1514 bytes, BW 9 Kbit, DLY 500000 usec,
```

```
reliability 255/255, txload 1/255, rxload 1/255
```

```
Encapsulation TUNNEL, loopback not set
```

```
Keepalive set (10 sec)
```

```
Tunnel source 202.1.0.18 (Serial0/0), destination 202.2.0.18
```

```
Tunnel protocol/transport GRE/IP, key disabled, sequencing disabled
```

```
Checksumming of packets disabled, fast tunneling enabled
```

```
!
```

```
<output omitted>
```

```
!
```

```
CHE#
```

## **BAN – Verification**

BAN # **show ip interface brief tunnel 0**

| Interface | IP-Address | OK? | Method | Status | Protocol |
|-----------|------------|-----|--------|--------|----------|
| Tunnel0   | 1.1.1.1    | YES | manual | up     | up       |

BAN #

BAN # **sh int tunnel 0**

Tunnel0 is up, line protocol is up

Hardware is Tunnel

Internet address is 1.1.1.2/24

MTU 1514 bytes, BW 9 Kbit, DLY 500000 usec,  
reliability 255/255, txload 1/255, rxload 1/255

Encapsulation TUNNEL, loopback not set

Keepalive set (10 sec)

Tunnel source 202.2.0.18 (Serial0/1), destination 202.1.0.18

Tunnel protocol/transport GRE/IP, key disabled, sequencing disabled

Checksumming of packets disabled, fast tunneling enabled

!

<output omitted>

!

BAN #

## **Configure Routing**

### **CHE – Configuration**

CHE # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

CHE (config) # **ip route 192.168.203.0 255.255.255.0 tunnel 0**

CHE (config) #

### **BAN – Configuration**

BAN # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

BAN (config) # **ip routing**

CHE (config) # **ip route 192.168.201.0 255.255.255.0 tunnel 0**

BAN (config) #



## Verify Routing

### CHE – Verification:

#### CHE # **show ip route**

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area  
\* - candidate default, U - per-user static route, o - ODR  
P - periodic downloaded static route

Gateway of last resort is not set

```
C 172.16.0.0/16 is directly connected, Serial0/0
C 192.168.201.0/24 is directly connected, FastEthernet0/0
S 192.168.203.0/24 [1/0] directly connected, Tunnel0
S* 0.0.0.0/0 [1/0] via Serial0/0
```

CHE #

### BAN – Verification:

#### BAN # **show ip route**

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area  
\* - candidate default, U - per-user static route, o - ODR  
P - periodic downloaded static route

Gateway of last resort is not set

```
C 172.16.0.0/16 is directly connected, Serial0/1
C 192.168.203.0/24 is directly connected, FastEthernet0/0
S 192.168.201.0/24 [1/0] directly connected, Tunnel0
S* 0.0.0.0/0 [1/0] via Serial0/1
```

BAN #

## Verify communication between the networks

### Verification from a Computer in CHE Network by pinging a computer in the BAN network

**ping 192.168.203.10**

```
PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.  
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms
```

### Verification from a Computer in BAN Network by pinging a computer in the CHE network

**ping 192.168.201.10**

```
PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.  
64 bytes from 192.168.201.10: icmp_seq=25 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp_seq=26 ttl=62 time=24.1 ms  
64 bytes from 192.168.201.10: icmp_seq=27 ttl=62 time=24.3 ms  
64 bytes from 192.168.201.10: icmp_seq=28 ttl=62 time=24.2 ms  
64 bytes from 192.168.201.10: icmp_seq=29 ttl=62 time=24.2 ms
```

### From a Computer in CHE Network trace communication path to a Computer in BAN Network

```
tracert 192.168.203.10 (Windows) or traceroute 192.168.203.10 (Linux)  
traceroute to 192.168.203.10 (192.168.203.10), 30 hops max, 38 byte packets  
 1  192.168.201.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms  
 2  1.1.1.1 (1.1.1.1)  2.295 ms  2.156 ms  2.209 ms  
 3  192.168.203.10 (192.168.203.10)  3.295 ms  3.156 ms  3.209 ms
```

### From a Computer in BAN Network trace communication path to a Computer in CHE Network

```
tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)  
traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets  
 1  192.168.203.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms  
 2  1.1.1.2 (1.1.1.2)  2.295 ms  2.156 ms  2.209 ms  
 3  192.168.201.10 (192.168.202.10)  3.295 ms  3.156 ms  3.209 ms
```



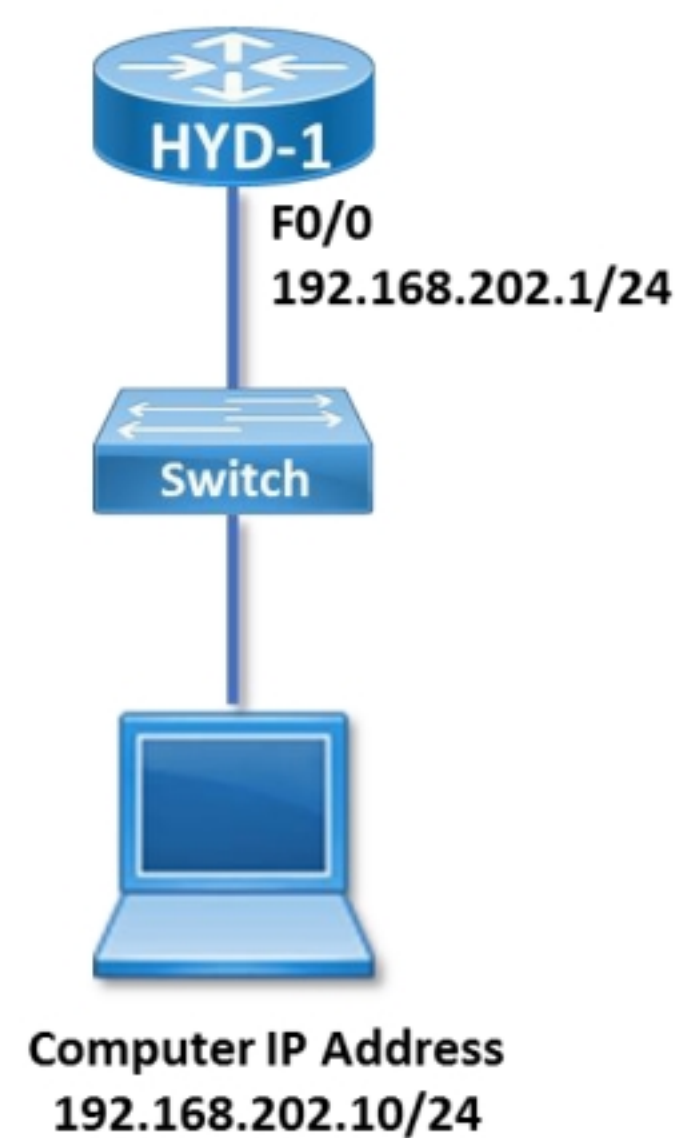
## LAB 42 : ENHANCING ROUTER SECURITY

### OBJECTIVE:

To enhance router security by authentication and enabling ssh access on router.

### TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



**Pre-requisite:** 192.168.202.10 computer should have Radius Server software installed and running.

### TASK:

- Configure Local Authentication
- Verify Local Authentication
- Configure AAA Authentication (Radius Server)
- Verify AAA Authentication
- Configure the SSH Server on Router
- Verify SSH access to Router

## Configure Local Authentication

### Example - HYD-1

#### Configure a new user with password

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **username zoom password cisco**

HYD-1 (config) #

#### Enabling userwise access for VTY session

HYD-1 (config) # **line vty 0 4**

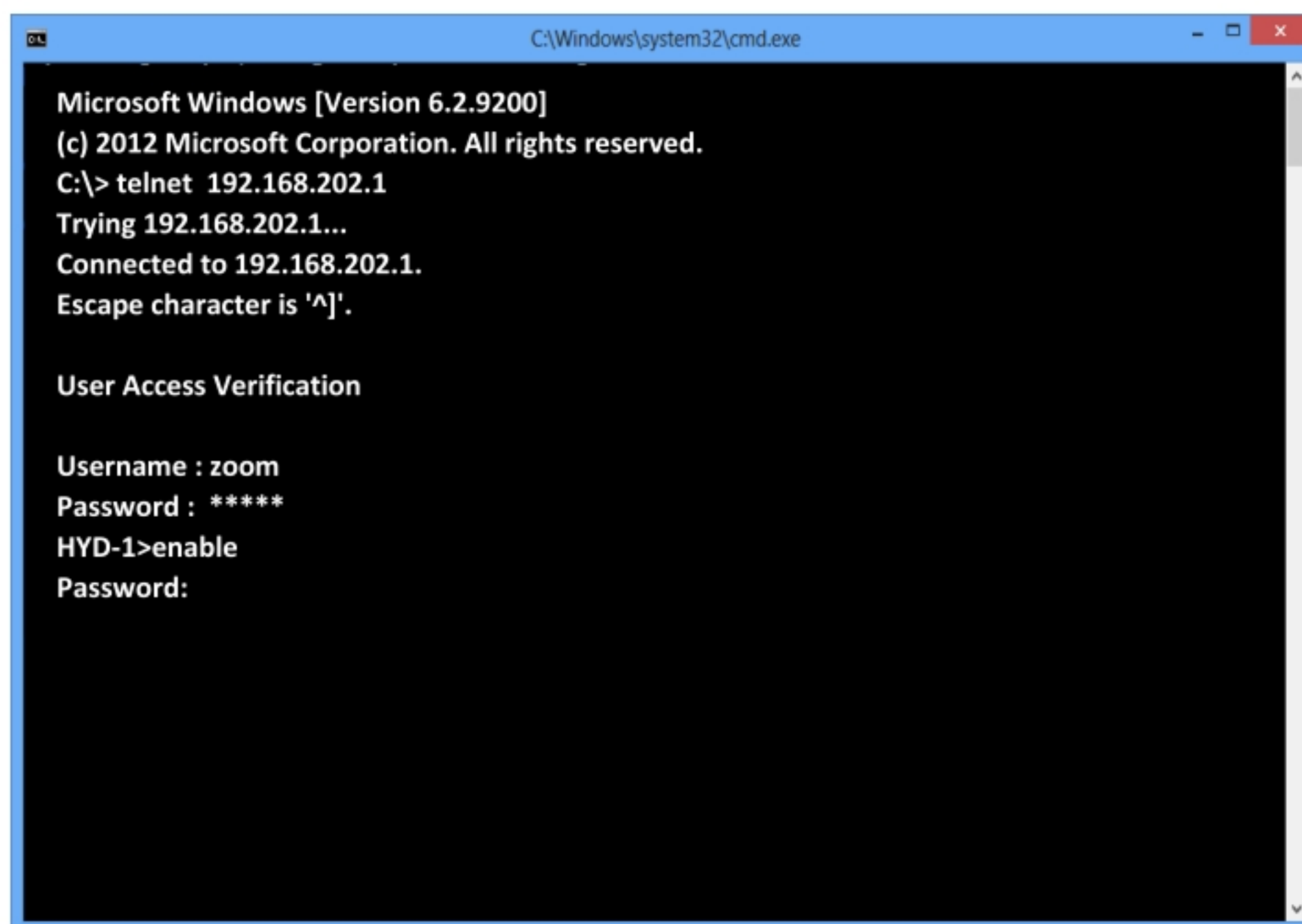
HYD-1 (config-line) # **login local**

HYD-1 (config-line) # **end**

## Verify Local Authentication

Now open a new telnet session from your computer to the router and try to login using already configured user.

i.e. **telnet 192.168.202.1**



```
C:\Windows\system32\cmd.exe

Microsoft Windows [Version 6.2.9200]
(c) 2012 Microsoft Corporation. All rights reserved.

C:\> telnet 192.168.202.1
Trying 192.168.202.1...
Connected to 192.168.202.1.
Escape character is '^]'.

User Access Verification

Username : zoom
Password : *****
HYD-1>enable
Password:
```



## Configure AAA Authentication (Radius Server)

### Example - HYD-1

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **aaa new-model**

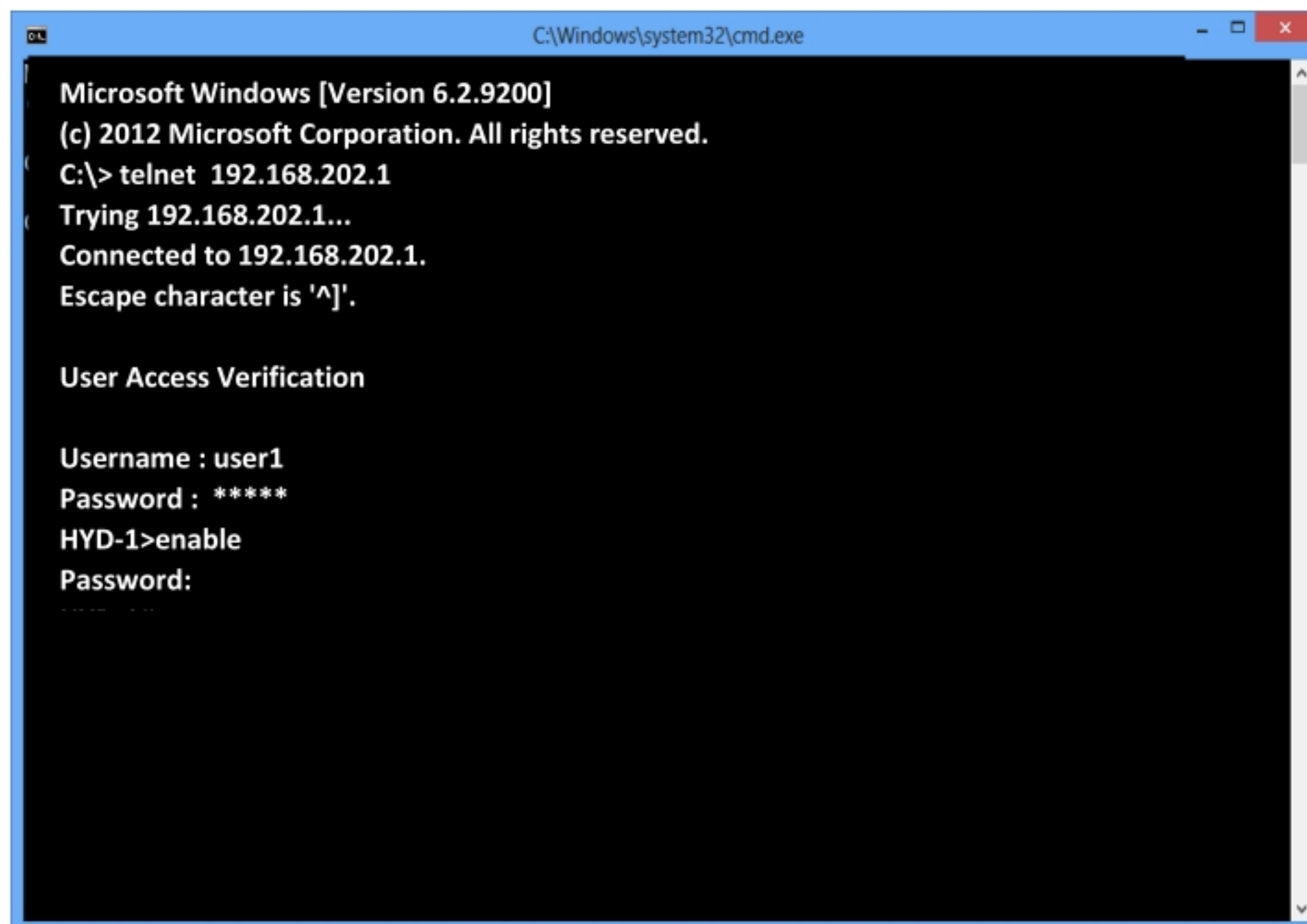
HYD-1 (config) # **radius-server host 192.168.202.10 key cisco**

HYD-1 (config) # **aaa authentication login default group radius local**

### Verify AAA Authentication

Create New User on Radius Server. Try to login using newly created user by opening a new telnet session from your computer to the router.

i.e. **telnet 192.168.202.1**



```
C:\Windows\system32\cmd.exe
Microsoft Windows [Version 6.2.9200]
(c) 2012 Microsoft Corporation. All rights reserved.
C:\> telnet 192.168.202.1
Trying 192.168.202.1...
Connected to 192.168.202.1.
Escape character is '^]'.

User Access Verification

Username : user1
Password : *****
HYD-1>enable
Password:
```

## Configure the SSH Server on Router

### Configure a domain name

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ip domain-name zoom.com**

### Configure the vty lines.

HYD-1 (config) # **line vty 0 4**

HYD-1 (config-line) # **login local**

HYD-1 (config-line) # **transport input ssh**

HYD-1 (config-line) # **exit**

### Generate the RSA encryption key pair for the router

HYD-1 (config) # **crypto key generate rsa**

The name for the keys will be: HYD-1.zoom.com

Choose the size of the key modulus in the range of 360 to 2048 for your

General Purpose Keys. Choosing a key modulus greater than 512 may take a few minutes.

How many bits in the modulus [512]: **1024**

% Generating 1024 bit RSA keys, keys will be non-exportable...

[OK] (elapsed time was 3 seconds)

R1 (config)# **end**

R1 #

## Verify SSH access to Router

Now open a new telnet session from your computer to the router, you will not be able to access the router via telnet.

Verify SSH access to HYD-1 from computer by giving below command :

**ssh -l zoom 192.168.202.1**

```

Shell - Konsole <2>
bt ~ #
bt ~ #
bt ~ # ssh -l zoom 10.0.0.1
The authenticity of host '10.0.0.1 (10.0.0.1)' can't be established.
RSA key fingerprint is 1d:3b:15:64:86:56:7c:2b:cd:b3:1c:84:47:4e:f0:72.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '10.0.0.1' (RSA) to the list of known hosts.
Password:
=====
UNAUTHORISED ACCESS STRICTLY PROHIBITED AND PROSECUTED
TO THE FULL EXTENT OF THE LAW
=====
R1>
R1>Connection to 10.0.0.1 closed by remote host.
Connection to 10.0.0.1 closed.
bt ~ #
bt ~ #
bt ~ #
bt ~ #
bt ~ #
bt ~ #
bt ~ #
bt ~ #
bt ~ #
bt ~ #
bt ~ #
bt ~ #
bt ~ #

```



## LAB 43: DHCP SERVER AND CLIENT

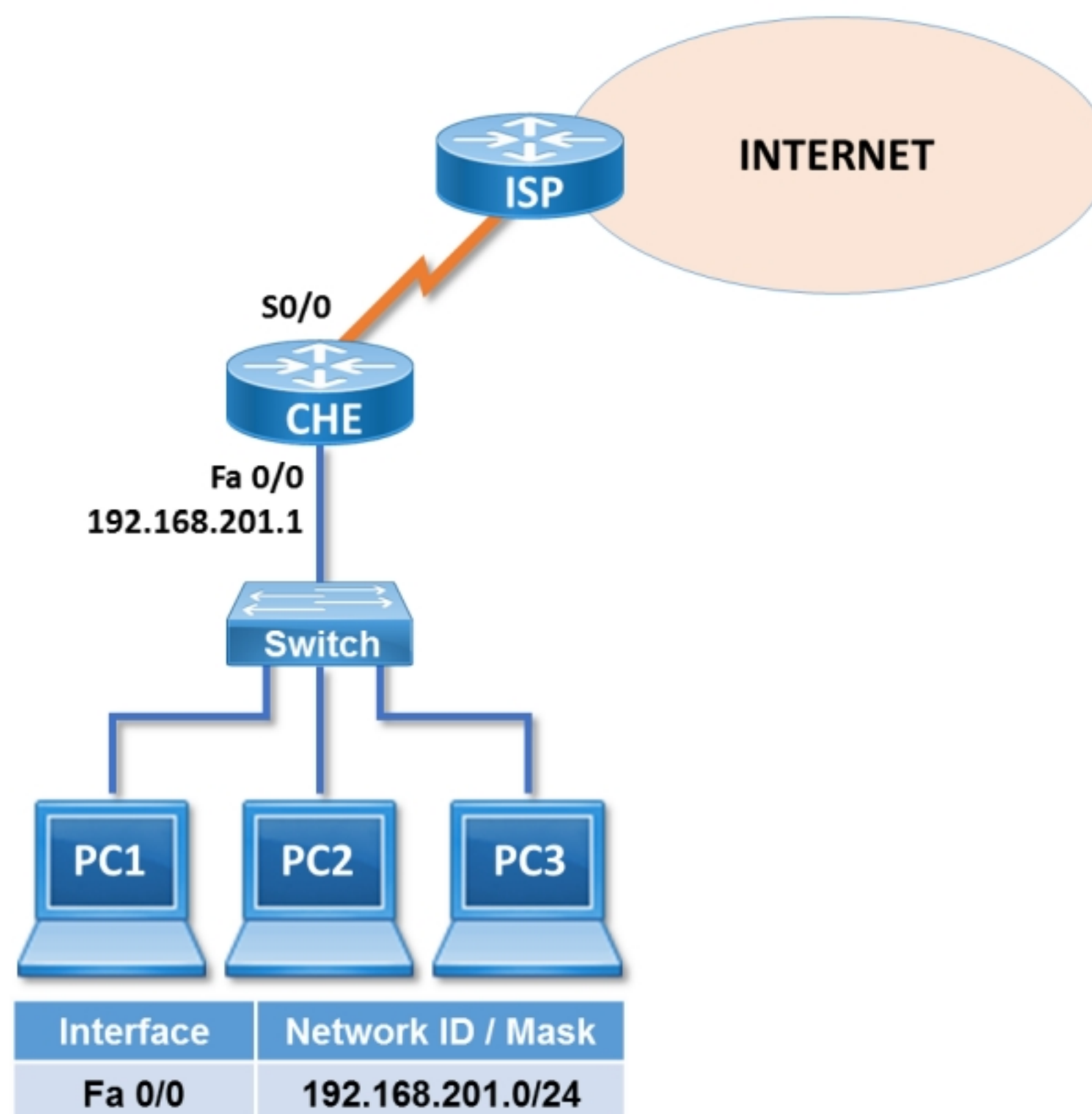
### OBJECTIVE:

To configure a Router as a DHCP Server for assigning IP addresses, DNS, gateway, etc. to client computers.

To configure an interface of Router as a DHCP Client for getting IP addresses from ISP.

### TOPOLOGY:

Setup the router for the lab as below:



### TASK:

- Configure Router as DHCP Server
- Verify DHCP on client computer
- Verify DHCP Server
- Configure an interface of a Router as DHCP Client
- Verify DHCP Client

## Configure Router as DHCP Server

### CHE – Configuration

#### **CHE # configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

CHE (config) # **ip dhcp pool zoom**

CHE (dhcp-config) # **network 192.168.201.0 255.0.0.0**

CHE (dhcp-config) # **default-router 192.168.201.1**

CHE (dhcp-config) # **dns-server 8.8.8.8**

CHE (dhcp-config) # **lease 1 1 1**

CHE (dhcp-config) # **exit**

CHE (config) # **ip dhcp excluded-address 192.168.201.1 192.168.201.50**

CHE (config)# **exit**

### Verify DHCP on client computer

**On Windows Computer**, Select **Obtain IP Address Automatically** in Network Properties and verify the dhcp ip address by giving **ipconfig** command on command prompt.

**On Linux Computer** give below commands

#### **# dhclient**

Internet Systems Consortium DHCP Client V3.0.6

Copyright 2004-2007 Internet Systems Consortium.

Sending on LPF/eth0/00:1b:b9:9a:16:8d

Sending on Socket/fallback

DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 8

DHCPOFFER from 192.168.201.5

DHCPREQUEST on eth0 to 255.255.255.255 port 67

DHCPACK from 192.168.201.5

bound to 192.168.201.5 -- renewal in 40650 seconds.

#### **# ifconfig**

eth0 Link encap:Ethernet HWaddr 00:1B:B9:9A:16:8D

inet addr:192.168.201.5 Bcast:92.168.201.255 Mask:255.0.0.0

UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1

RX packets:9263 errors:0 dropped:0 overruns:0 frame:0



## Verify DHCP Server

### CHE – Verification:

CHE # **show ip dhcp binding**

Bindings from all pools not associated with VRF:

| IP address     | Client-ID/<br>Hardware address/<br>User name | Lease expiration     | Type      |
|----------------|--|----------------------|-----------|
| 192.168.202.5  | 001c.c06c.91f3                               | Aug 27 2016 02:21 PM | Automatic |
| 192.168.202.10 | 001b.b99a.168d                               | Aug 27 2016 02:25 PM | Automatic |

CHE #

## Configure an interface of a Router as DHCP Client

### CHE – Configuration

CHE # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

CHE (config)# **interface serial 0/0**

CHE (config-if)# **ip address dhcp**

CHE (config-if)# **no shutdown**

CHE (config-if)# **exit**

CHE (config)#

## Verify DHCP Client

CHE # **show interface serial 0/0**

Serial0/0 is up, line protocol is up

Hardware is PowerQUICC Serial

Internet address is 202.1.0.18/29

MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,  
reliability 255/255, txload 1/255, rxload 1/255

Encapsulation HDLC, loopback not set

Keepalive set (10 sec)

!

<output omitted>

!

CHE #

CHE # **show ip interface brief**

| Interface       | IP-Address    | OK? | Method | Status                | Protocol |
|-----------------|---------------|-----|--------|-----------------------|----------|
| FastEthernet0/0 | 192.168.202.1 | YES | NVRAM  | up                    | up       |
| Serial0/0/0     | 202.1.0.18    | YES | DHCP   | up                    | up       |
| Serial0/0/1     | unassigned    | YES | manual | administratively down | down     |

CHE #

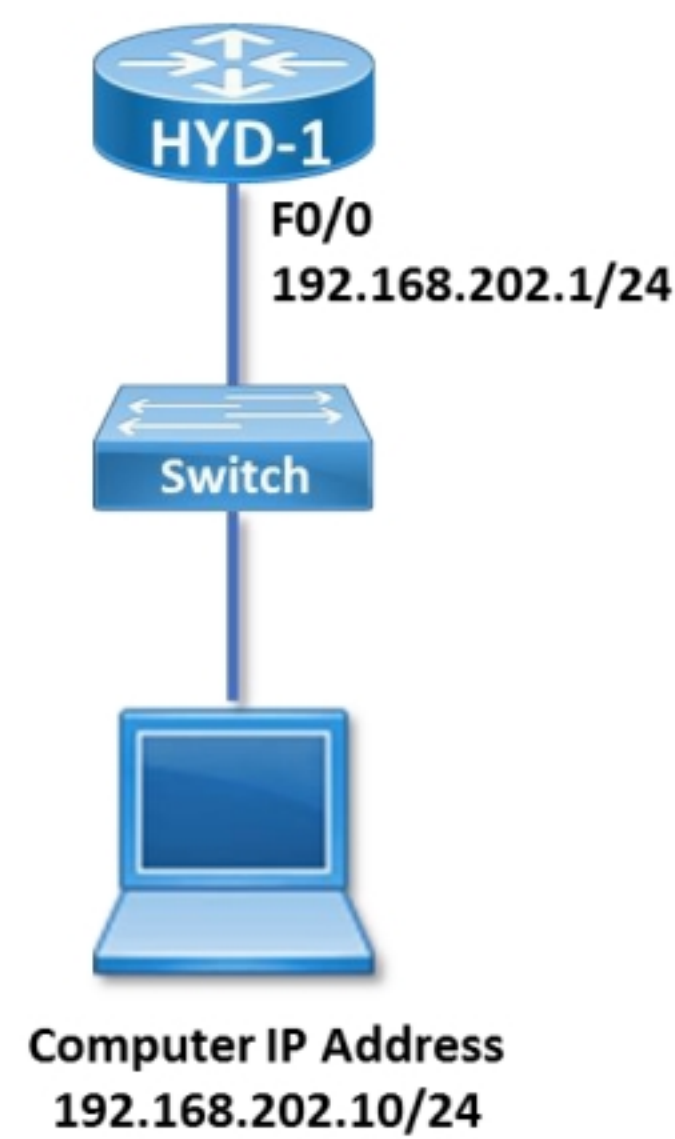
## LAB 44: SNMP

### OBJECTIVE:

To configure router as SNMP Agent and sending snmp traps to a SNMP server.

### TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



**Pre-requisite:** 192.168.202.10 computer should have SNMP server software installed and running.

### TASK:

- Configure Router as SNMP Agent
- Generate and Verify SNMP Traps



## Configure Router as SNMP Agent

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **snmp-server community public rw**

HYD-1 (config) # **snmp-server host 192.168.202.10 version 2c public**

HYD-1 (config) # **snmp-server enable traps**

HYD-1 (config) # **exit**

HYD-1 #

### Generate and Verify SNMP Traps

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **interface serial 0/0/0**

HYD-1 (config-if) # **shutdown**

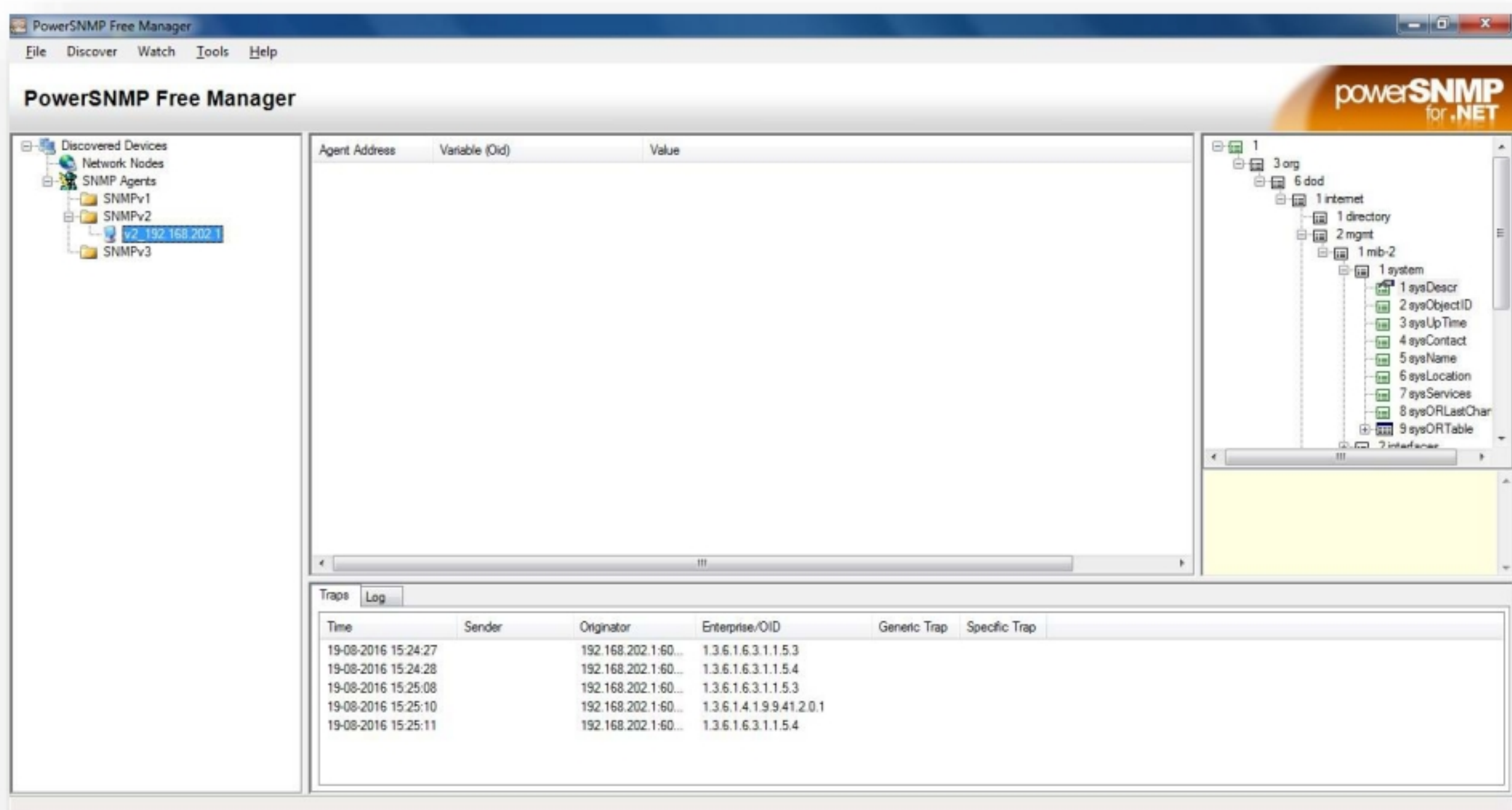
HYD-1 (config-if) # **no shutdown**

HYD-1 (config-if) # **end**

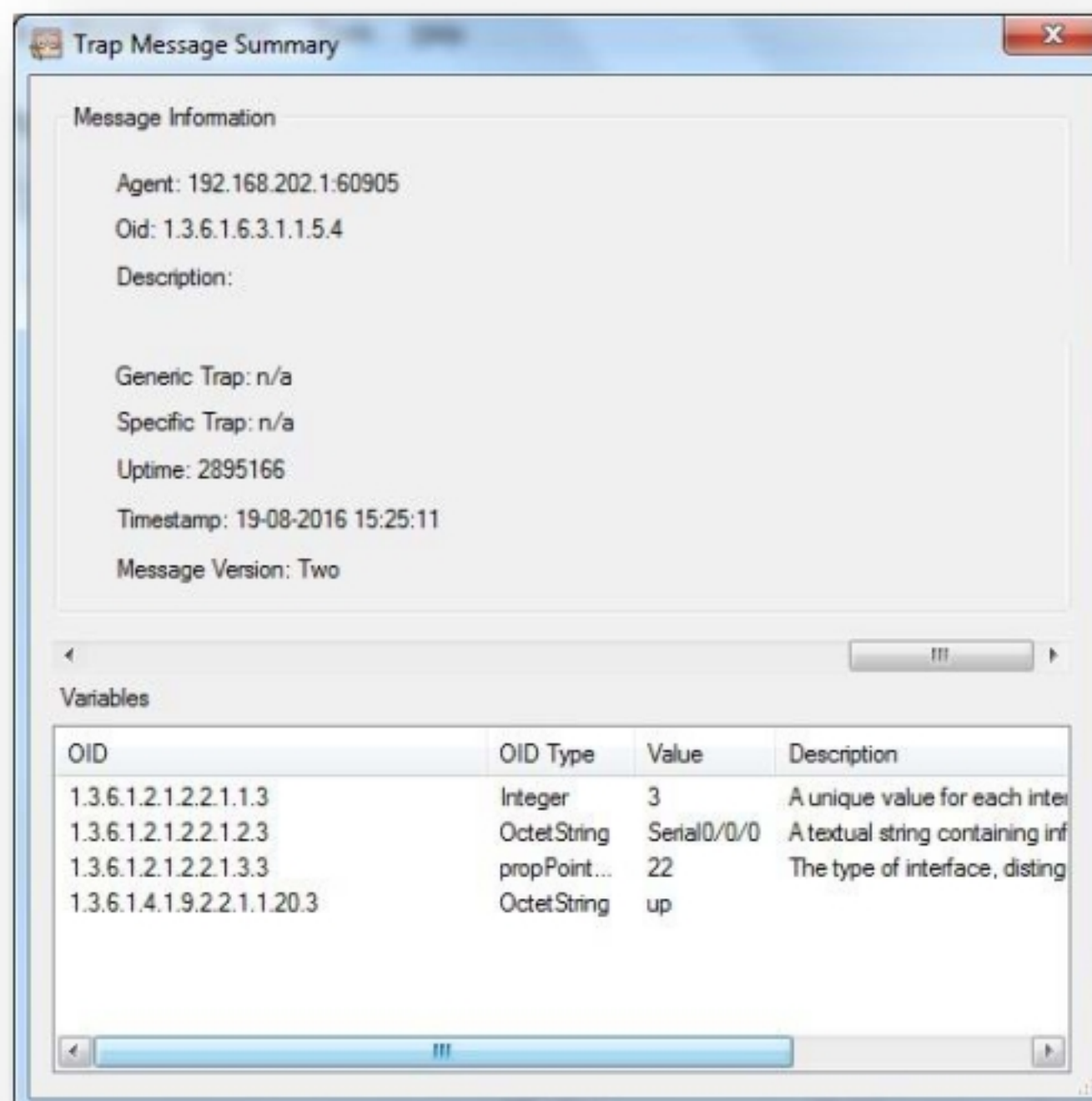
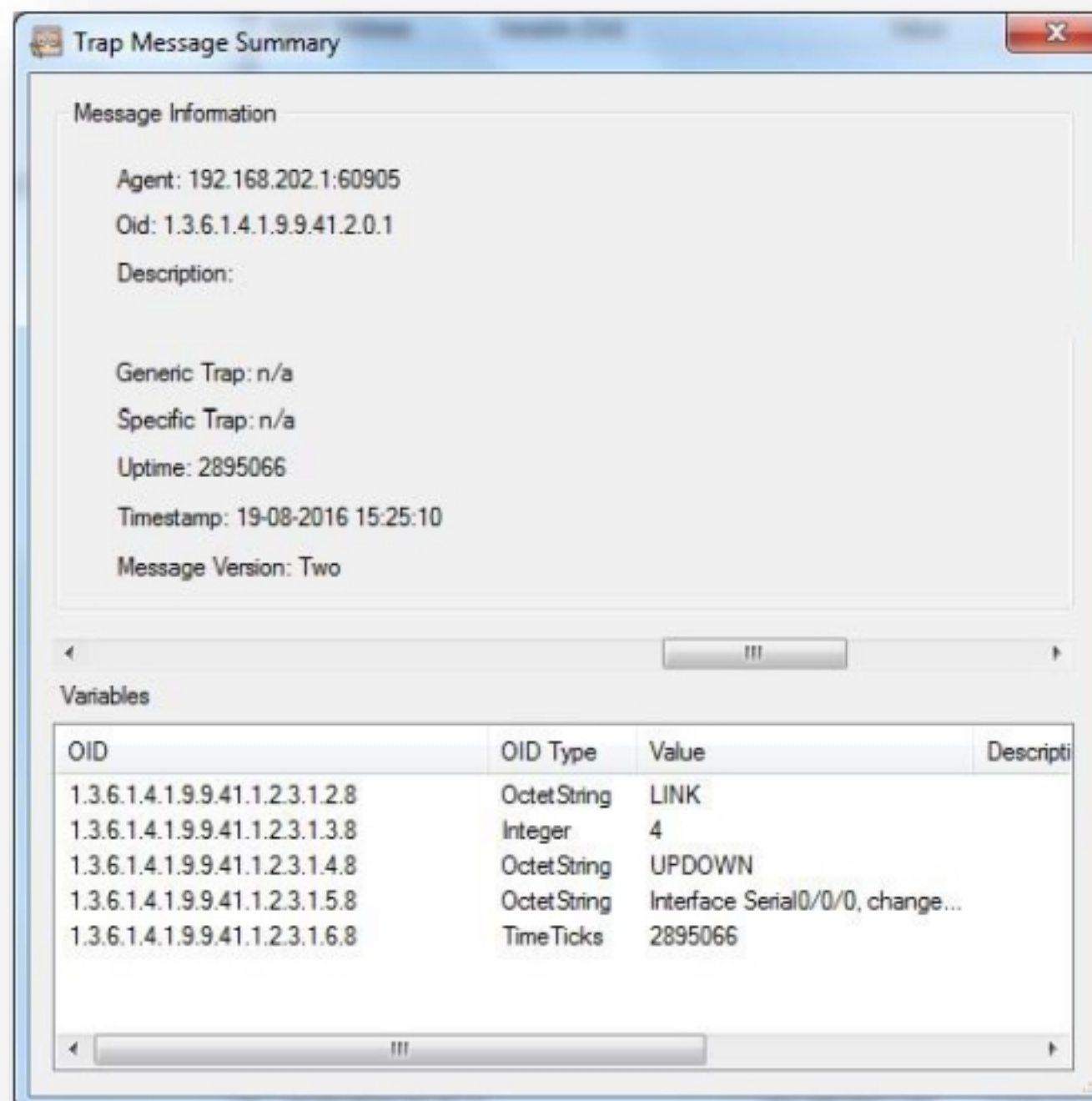
HYD-1 #

### Verification on SNMP Server (PC) :

Start **SNMP software** to view the SNMP traps as below :



Below screenshot of SNMP trap gives detailed information of change in Interface status :





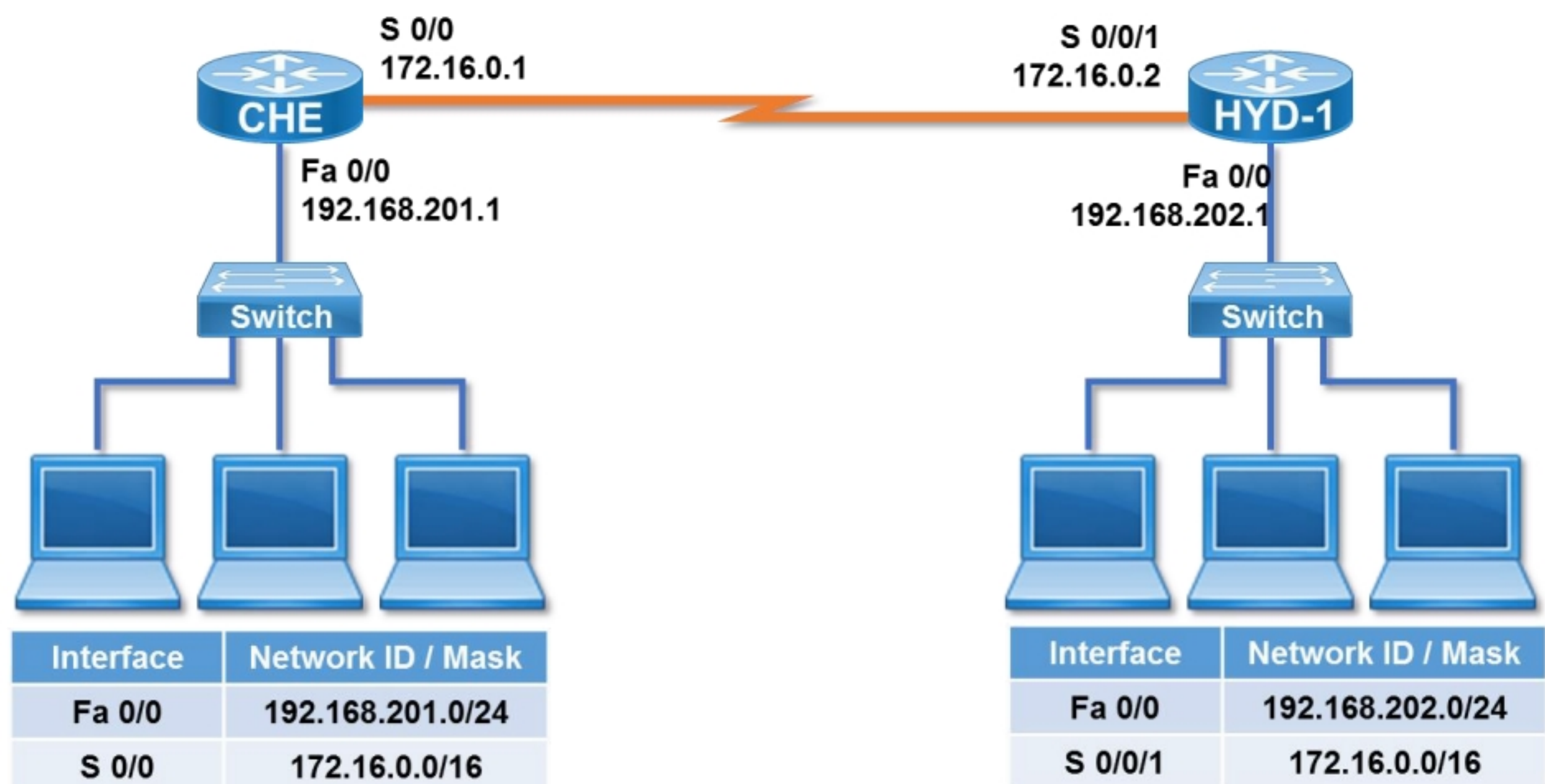
## LAB 45: PPP AUTHENTICATION

### OBJECTIVE:

To enable PPP authentication between routers

### TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below:



### TASK:

- Configure Serial Interface
- Verify Serial Interface Configuration
- Configure PPP Authentication (CHAP)
- Verify Serial Interface set up
- Troubleshoot PPP Authentication

## Configure Serial Interface

### CHE – Configuration

CHE # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

CHE (config)# **interface serial 0/0**

CHE (config-if)# **ip address 172.16.0.1 255.255.0.0**

CHE (config-if)# **no shutdown**

CHE (config-if)# **clock rate 64000**

CHE (config-if)# **encapsulation ppp**

CHE (config-if)# **exit**

CHE (config)#

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config)# **interface serial 0/0/1**

HYD-1 (config-if)# **ip address 172.16.0.2 255.255.0.0**

HYD-1 (config-if)# **no shutdown**

HYD-1 (config-if)# **encapsulation ppp**

HYD-1 (config-if)# **exit**

HYD-1 (config)# **exit**

## Verify Serial Interface Configuration

### CHE – Verification

CHE # **show interface serial 0/0**

Serial0/0 is up, line protocol is up

Hardware is PowerQUICC Serial

Internet address is 172.16.0.1/16

MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,

reliability 255/255, txload 1/255, rxload 1/255

Encapsulation PPP, loopback not set

Keepalive set (10 sec)

LCP Open

Open: IPCP, CDPCP

!

<output omitted>

!

CHE #



### HYD-1 – Verification:

```
HYD-1 # show interface serial 0/0/1
Serial0/0/1 is up, line protocol is up
  Hardware is GT96K Serial
  Internet address is 172.16.0.2/16
    MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
      reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, loopback not set
    Keepalive set (10 sec)
  LCP Open
  Open: IPCP, CDPCP
  !
<output omitted>
  !
HYD-1 #
```

### Configure PPP Authentication (CHAP)

#### CHE – Configuration

```
CHE # configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config) # username HYD-1 password cisco
CHE (config) # interface serial 0/0
CHE (config-if) # ppp authentication chap
CHE (config-if) # end
CHE #
```

#### HYD-1 – Configuration

```
HYD-1 # configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # username CHE password cisco
HYD-1 (config) # interface serial 0/0/1
HYD-1 (config-if) # ppp authentication chap
HYD-1 (config-if) # end
HYD-1 #
```

### Verify Serial Interface

#### CHE – Verification

```
CHE # show interface serial 0/0
Serial0/0 is up, line protocol is up
  Hardware is PowerQUICC Serial
  Internet address is 172.16.0.1/16
    MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
      reliability 240/255, txload 1/255, rxload 1/255
```

```
Encapsulation PPP, loopback not set
  Keepalive set (10 sec)
LCP Open
Open: IPCP, CDPCP
!
<output omitted>
!
CHE #
```

### **HYD-1 – Verification:**

```
HYD-1 # show interface serial 0/0/1
Serial0/0/1 is up, line protocol is up
  Hardware is GT96K Serial
  Internet address is 172.16.0.2/16
    MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
      reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, loopback not set
    Keepalive set (10 sec)
  LCP Open
  Open: IPCP, CDPCP
!
<output omitted>
!
HYD-1 #
```

### **Troubleshooting PPP Authentication**

After enabling PPP authentication, if you see the following output means, it means there is a problem with authentication configuration.

```
CHE # show interface serial 0/0
Serial0/0 is up, line protocol is down
  Hardware is PowerQUICC Serial
  Internet address is 172.16.0.1/16
    MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
      reliability 246/255, txload 1/255, rxload 1/255
  Encapsulation PPP, loopback not set
    Keepalive set (10 sec)
  LCP TERMsent
  Closed: IPCP, CDPCP
!
<output omitted>
!
CHE #
```



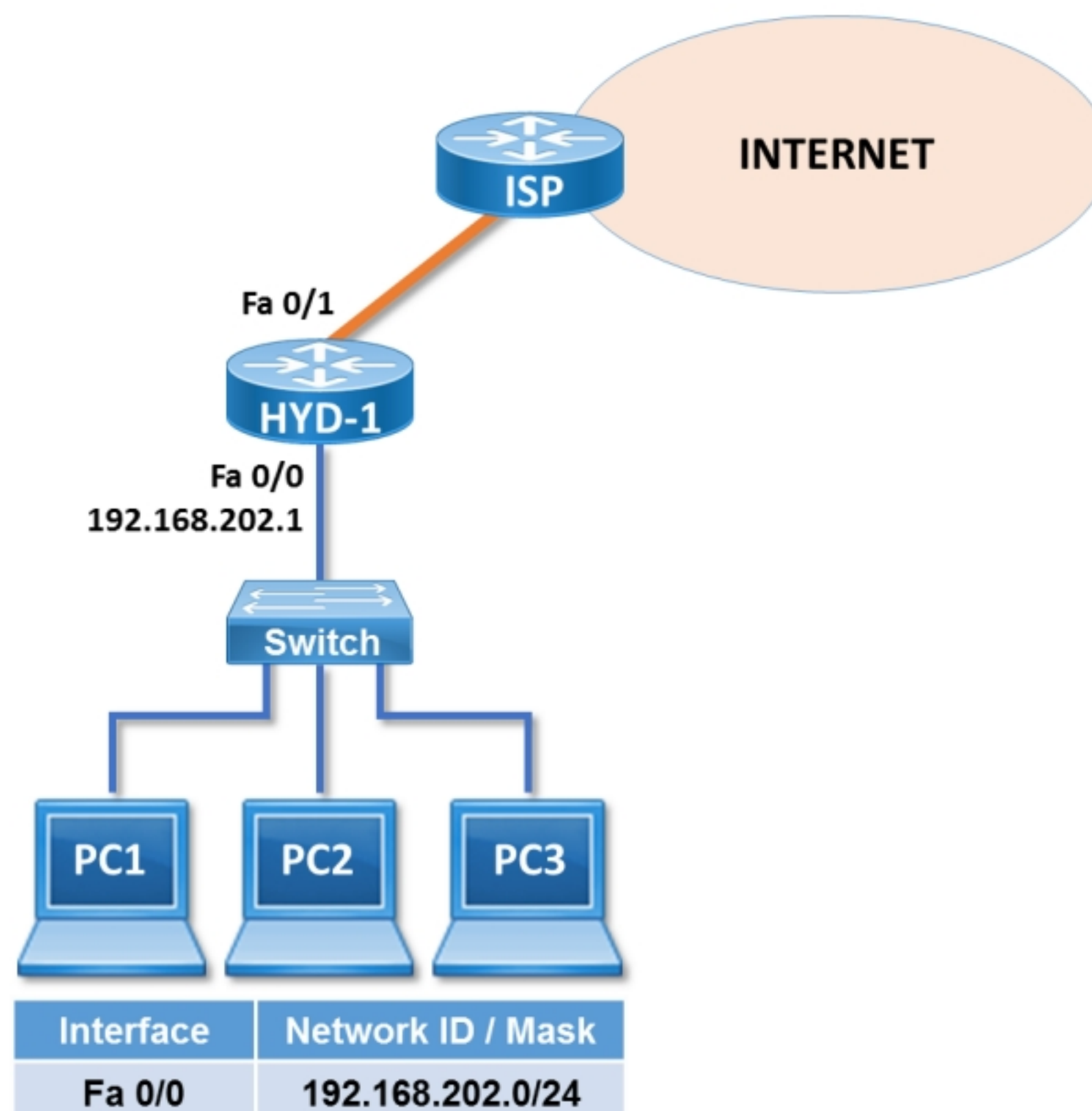
## LAB 46: Point-to-Point Protocol over Ethernet (PPPoE)

### OBJECTIVE:

To configure PPPOE client for accessing Internet.

### TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



### TASK:

- Configure PPPoE Client on Ethernet Interface
- Verify PPPoE Client
- Verify communication from LAN to the Internet

## Configure PPPoE on Ethernet Interface

Configure PPPoE on Ethernet Interface to get authenticated by ISP. After successful authentication IP addresses and default route are provided by ISP

### HYD-1 – Configuration

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **interface fastethernet 0/1**

HYD-1 (config-if) # **no ip address**

HYD-1 (config-if) # **pppoe enable**

HYD-1 (config-if) # **pppoe-client dial-pool-number 1**

HYD-1 (config-if) # **exit**

HYD-1 (config) # **interface dialer 1**

HYD-1 (config-if) # **mtu 1492**

HYD-1 (config-if) # **ip address negotiated**

HYD-1 (config-if) # **encapsulation ppp**

HYD-1 (config-if) # **ppp authentication pap callin**

HYD-1 (config-if) # **ppp pap sent-username cisco password ccna**

HYD-1 (config-if) # **dialer pool 1**

HYD-1 (config-if) # **ppp ipcp route default**

HYD-1 (config-if) # **end**

HYD-1 #

### Verify PPPoE Client

#### HYD-1 – Verification:

HYD-1 # **show interfaces dialer 1**

Dialer1 is up, line protocol is up (spoofing)

Hardware is Unknown

Internet address is 202.1.0.18/32

MTU 1492 bytes, BW 56 Kbit/sec, DLY 20000 usec,  
reliability 255/255, txload 1/255, rxload 1/255

Encapsulation PPP, LCP Closed, loopback not set

Keepalive set (10 sec)

DTR is pulsed for 1 seconds on reset

Interface is bound to Vi2

Last input never, output never, output hang never

Last clearing of "show interface" counters 00:04:10

Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0

Queueing strategy: weighted fair

Output queue: 0/1000/64/0 (size/max total/threshold/drops)

Conversations 0/0/16 (active/max active/max total)

Reserved Conversations 0/0 (allocated/max allocated)

Available Bandwidth 42 kilobits/sec

5 minute input rate 0 bits/sec, 0 packets/sec

5 minute output rate 0 bits/sec, 0 packets/sec



```

4 packets input, 56 bytes
10 packets output, 548 bytes
Bound to:
Virtual-Access2 is up, line protocol is up
Hardware is Virtual Access interface
MTU 1492 bytes, BW 56 Kbit/sec, DLY 20000 usec,
  reliability 255/255, txload 1/255, rxload 1/255
Encapsulation PPP, LCP Open
Stopped: CDPCP
Open: IPCP
PPPoE vaccess, cloned from Dialer1
Vaccess status 0x44, loopback not set
Keepalive set (10 sec)
!
<output omitted>
!
0 output buffer failures, 0 output buffers swapped out
0 carrier transitions
HYD-1#

```

#### HYD-1 # show ip interface brief

| Interface       | IP-Address    | OK? | Method | Status                | Protocol |
|-----------------|---------------|-----|--------|-----------------------|----------|
| FastEthernet0/0 | 192.168.201.1 | YES | NVRAM  | up                    | up       |
| FastEthernet0/1 | unassigned    | YES | manual | up                    | up       |
| Serial0/0/0     | unassigned    | YES | manual | administratively down | down     |
| Serial0/0/1     | unassigned    | YES | manual | administratively down | down     |
| Dialer1         | 202.1.0.18    | YES | IPCP   | up                    | up       |
| Virtual-Access1 | unassigned    | YES | unset  | up                    | up       |
| Virtual-Access2 | unassigned    | YES | unset  | up                    | up       |

HYD-1#

#### HYD-1 # show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
 E1 - OSPF external type 1, E2 - OSPF external type 2  
 i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
 ia - IS-IS inter area, \* - candidate default, U - per-user static route  
 o - ODR, P - periodic downloaded static route, + - replicated route

Gateway of last resort is 202.1.0.17 to network 0.0.0.0

```

S* 0.0.0.0/0 [1/0] via 202.1.0.17
10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C 10.0.0.0/8 is directly connected, FastEthernet0/0
L 10.0.0.1/32 is directly connected, FastEthernet0/0
202.1.0.0/32 is subnetted, 2 subnets
C 202.1.0.17 is directly connected, Dialer1
C 202.1.0.18 is directly connected, Dialer1
HYD-1#

```

**Verify communication from LAN to the Internet.****Verification from PC1**

**ping 8.8.8.8**

PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.

64 bytes from 8.8.8.8: icmp\_seq=1 ttl=62 time=24.0 ms

64 bytes from 8.8.8.8: icmp\_seq=2 ttl=62 time=24.0 ms

64 bytes from 8.8.8.8: icmp\_seq=3 ttl=62 time=24.1 ms

64 bytes from 8.8.8.8: icmp\_seq=4 ttl=62 time=24.0 ms



## LAB 47: PASSWORD RECOVERY

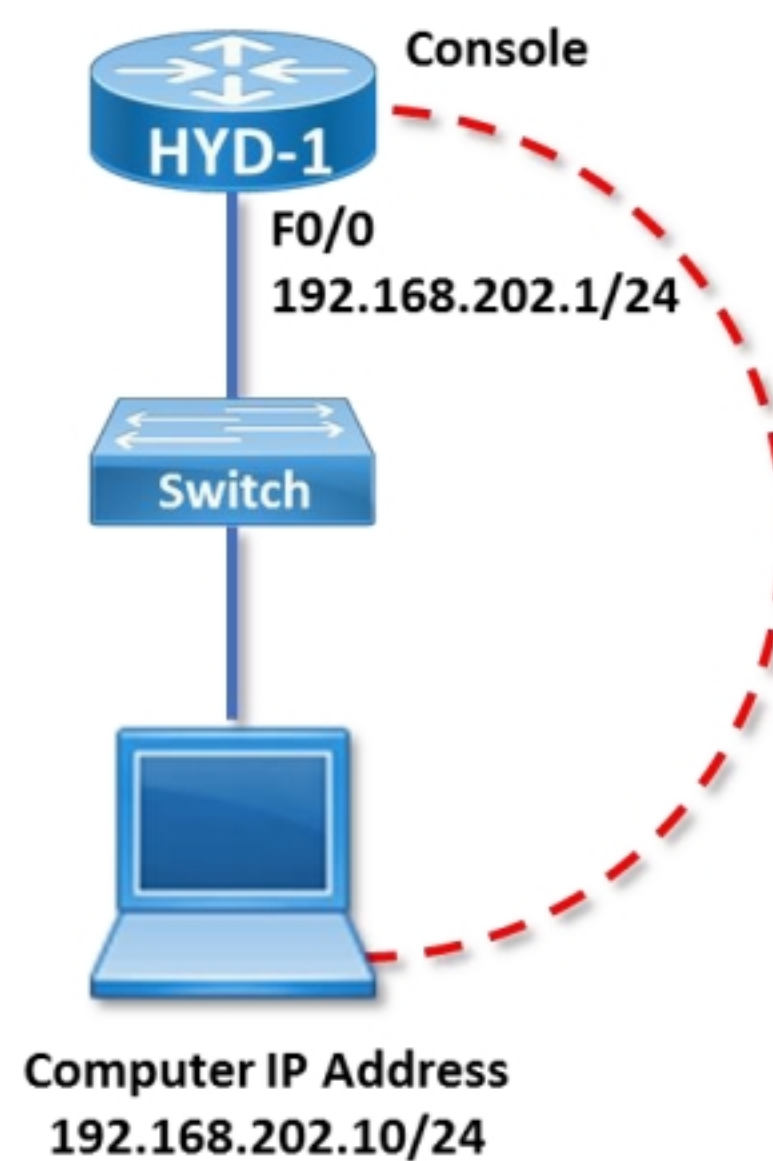
### OBJECTIVE:

To get access to a router's privileged mode in case the enable password is forgotten.

To reset the Privilege / Enable mode password of Cisco Router.

### TOPOLOGY:

Setup Console and Ethernet connectivity for the lab as below:



### TASK:

- Establish console connectivity
- Access router via console with an emulation software
- Enter Rom Monitor Mode and Change Register Value
- Load saved configuration to the router (i.e. NVRAM to RAM)
- Reconfigure Privilege Mode / Enable Password
- Reset the Configuration Register Value back to the default:
- Enable the Ethernet interface:
- Save configuration to the router and restart the router
- Verify login to the router using new password

### Establish console connectivity

Establish console connectivity by connecting router console port to PC Com Port with console cable.

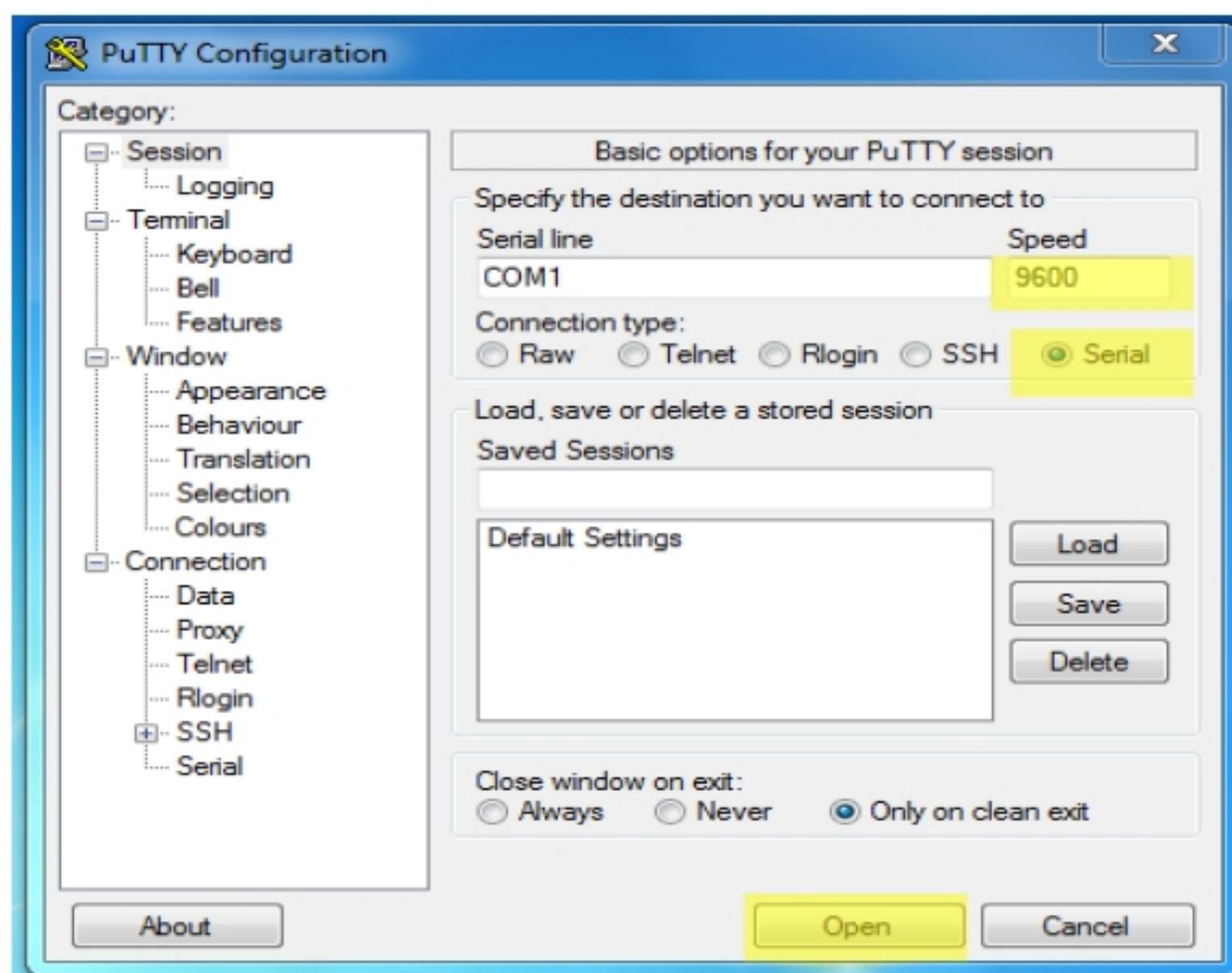
### Access router via console with an emulation software

Configure the following parameters in emulation software for accessing switch via console port.

| Parameters | Console Port Settings |
|------------|-----------------------|
| Baud       | 9600                  |
| Data bits  | 8                     |
| Parity     | None                  |
| Stop bits  | 1                     |

### Accessing router via console from Microsoft Windows Computer

- Start a terminal emulator application, such as **PUTTY.exe**
- Select **Serial** option and set speed to **9600**.
- Click **Open**



- Once emulation software is ready, **Power-ON** the switch.

### Accessing router via console from Linux Computer

- From the terminal enter the below command  
# **minicom**



### Enter Rom Monitor Mode and Change Configuration Register Value

Once emulation software is ready, Press “**Ctrl + Break**” within 60 sec after **POWER-ON**. Router will Enter **Rom monitor mode**.

```
rommon 1>
```

**Configure Register Value 0x2142 to skip executing the startup configuration from nvram during bootup.**

```
rommon 1 > confreg 0x2142  
rommon 2 > reset
```

**After the Router boots-up completely, it enters setup mode as below:**

```
System Configuration Dialog  
Would you like to enter the initial configuration dialog? [Yes/no]: no  
Would you like to terminate autoinstall? [yes]: yes
```

If you choose “Yes”, IOS will prompt questions to gather the information to configure the Router, it is recommended to choose “no”, since we can configure the Router using IOS commands

```
Router >enable
```

### Load saved configuration to the router

```
Router # copy startup-config running-config  
Destination filename [running-config]?  
HYD-1 #
```

### Reconfigure Privilege Mode / Enable Password

Since we are already in the privilege mode, we can setup a new privilege password.

```
HYD-1 # configure terminal  
HYD-1 (config) # enable secret cisco  
HYD-1 (config) # exit
```

### Reset the Configuration Register Value back to the default:

```
HYD-1 (config)# config-register 0x2102
```

### Enable the Ethernet interface:

```
HYD-1 (config)# interface FastEthernet0/0  
HYD-1 (config-if)# no shutdown  
HYD-1 (config-if)# ^Z
```

Similarly apply the “no shutdown” command on all required interface

### Saving configuration to the router and restart the router

To save configuration on router

```
HYD-1 # copy running-config startup-config
```

```
Destination filename [startup-config]?
```

```
Building configuration...
```

```
[OK]
```

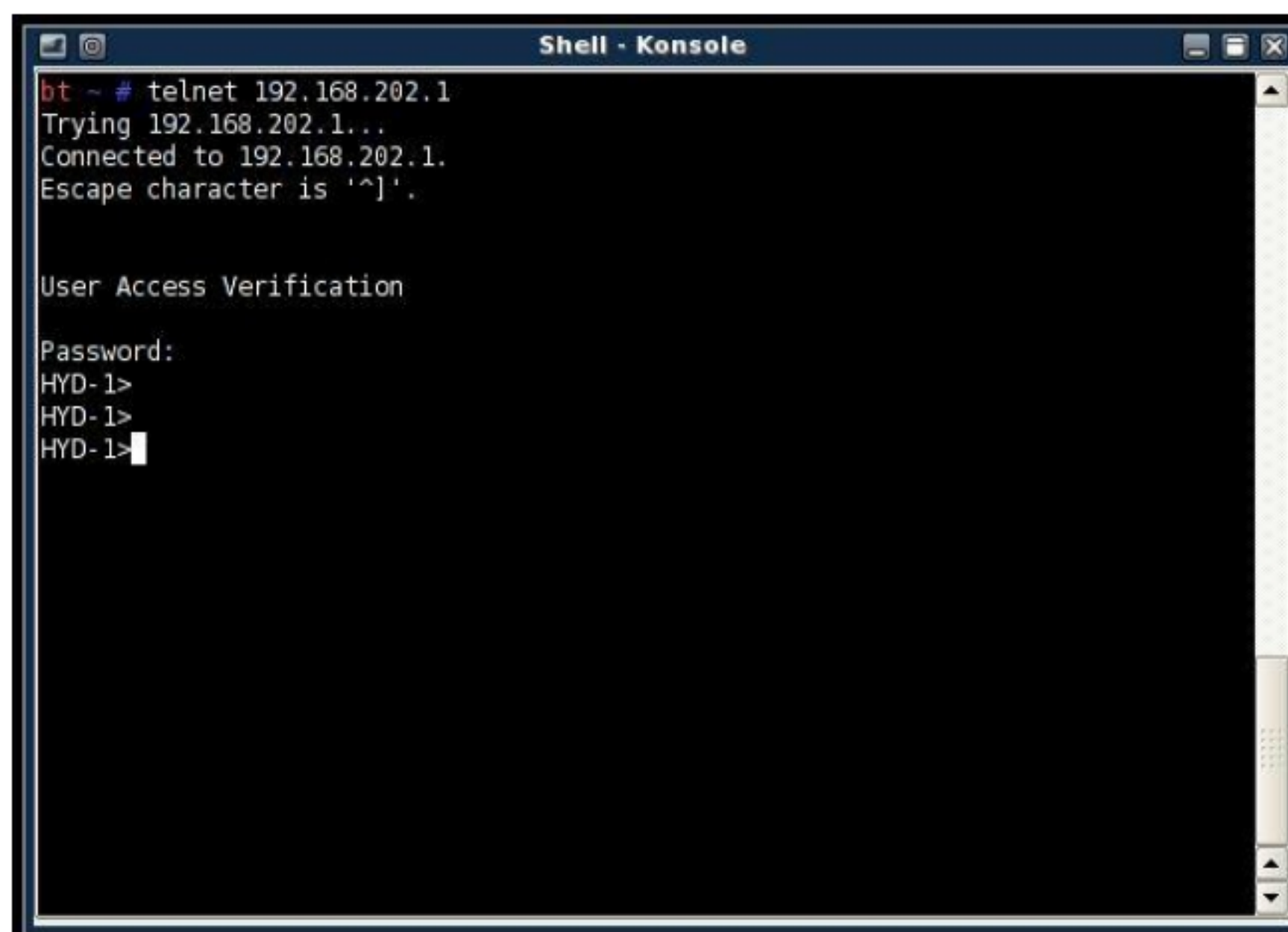
```
HYD-1 #
```

```
HYD-1 # reload
```

### Verify login to the router using new password

- Access router via telnet and Enter privilege mode using new password.

```
telnet 192.168.202.1
```





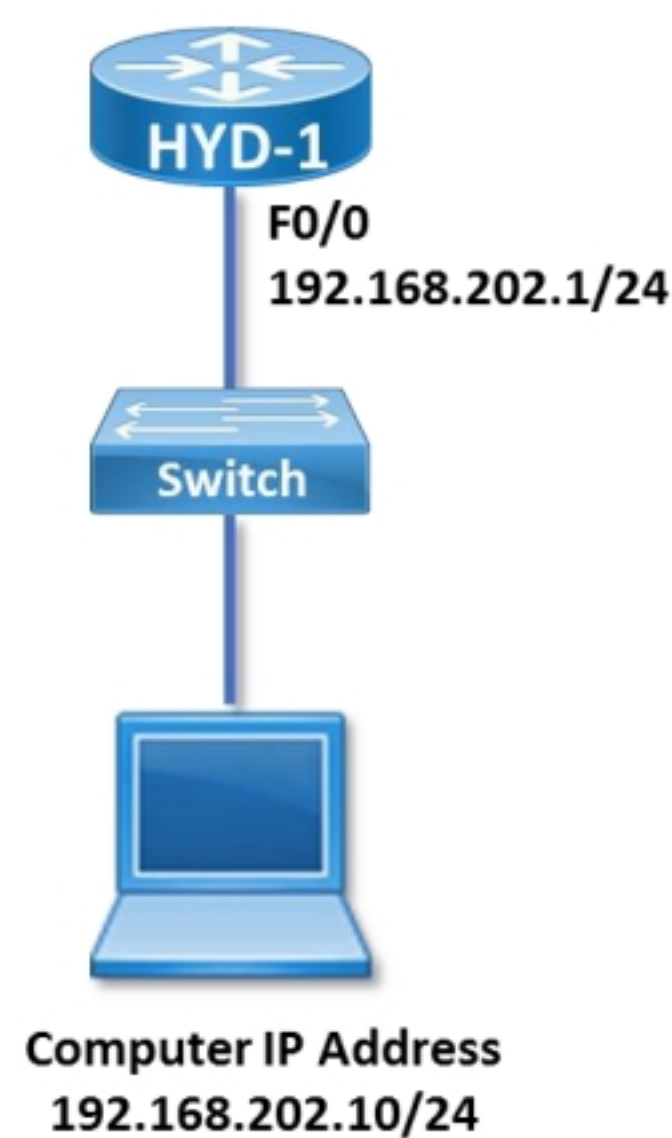
## LAB 48: IOS AND CONFIGURATION BACKUP

### OBJECTIVE:

To take backup of the IOS and the Router Configuration

### TOPOLOGY:

Setup Ethernet connectivity for the lab as below:



**Pre-requisite:** 192.168.202.10 computer should have TFTP , FTP and SCP server software installed and running.

### TASK:

- Create a backup of Router Configuration on TFTP Server
- Verify Configuration file on TFTP server
- Create a Backup of Router IOS on TFTP Server
- Verify IOS file on TFTP server
- Create a backup of Router Configuration on FTP Server
- Verify Configuration file on FTP server
- Create a Backup of Router IOS on FTP Server
- Verify IOS file on FTP server

## Backup of Router Configuration on TFTP Server

HYD-1 # **copy startup-config tftp**

Address or name of remote host []? **192.168.202.10**

Destination filename [HYD-config]? **HYD-TFTP**

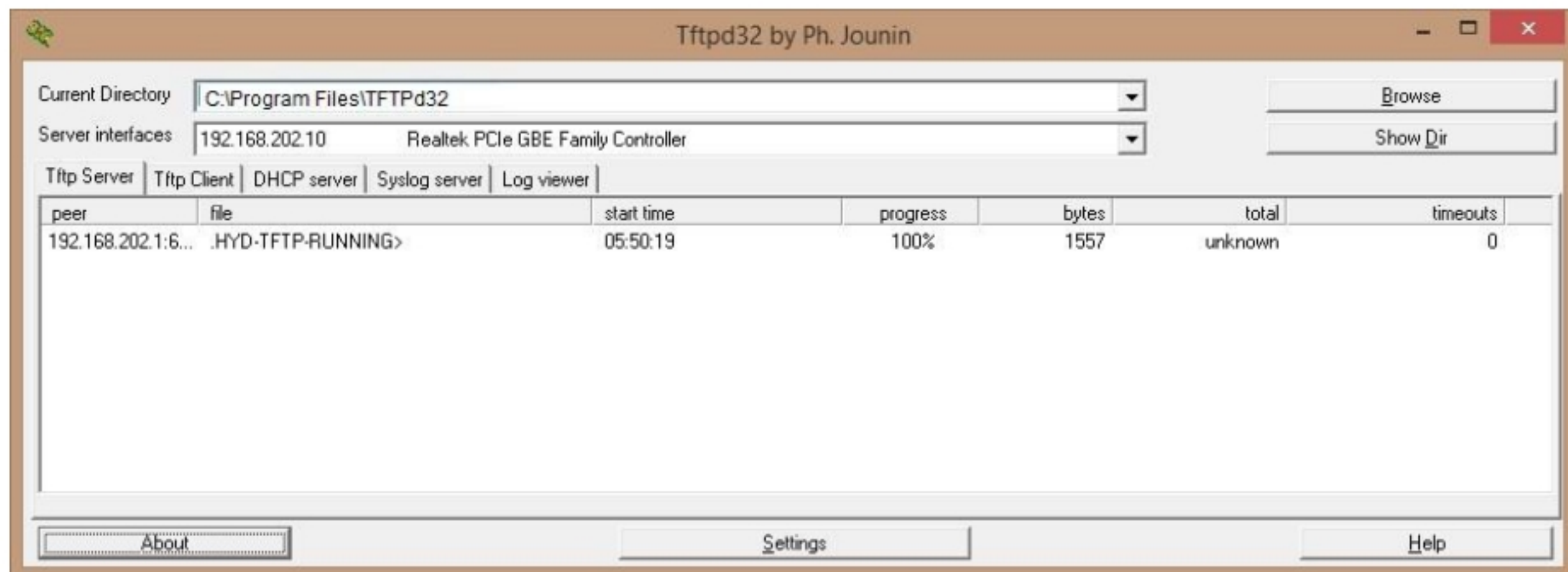
!!

1514 bytes copied in 0.344 secs (4401 bytes/sec)

HYD-1 #

## Verify backup configuration file on TFTP Server

Verify the Configuration file on TFTP server, default path is **C:\Program Files\TFTPd32**



## Backup of Router IOS

HYD-1 # **show flash**

System flash directory:

File Length Name/status

1 63139972 Aug 01 2016 14:13:20 c2800nm-adventerprisek9-mz.151-1.T.bin

856064 bytes available (63156224 bytes used)

HYD-1 #

HYD-1 # **copy flash tftp**

Source filename []? **C2800NM-ADVENTERPRISEK9-MZ.151-1.T.BIN**

Address or name of remote host []? **192.168.202.10**

Destination filename [C2800NM-ADVENTERPRISEK9-MZ.151-1.T.BIN]?

!!  
 !!!  
 !!!  
 !!!

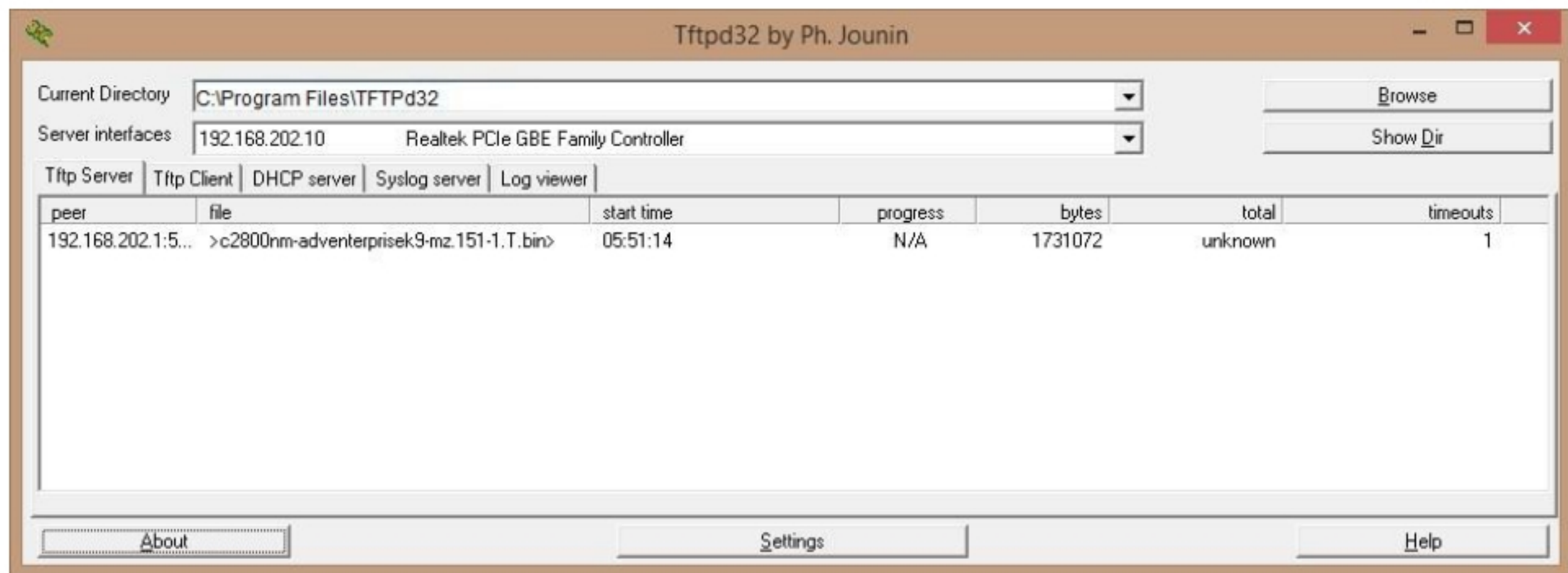
63139972 bytes copied in 264.584 secs (238639 bytes/sec)

HYD-1 #



## Verify backup IOS file on TFTP server

Verify the IOS file on TFTP server, default path is **C:\Program Files\TFTPd32**



## Backup of Router Configuration on FTP Server

HYD-1 # **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

HYD-1 (config) # **ip ftp username cisco**

HYD-1 (config) # **ip ftp password ccna**

HYD-1 (config) # **end**

HYD-1 # **copy startup-config ftp:**

Address or name of remote host []? **192.168.202.10**

Destination filename [HYD-config]? **HYD-FTP**

Writing HYD-FTP !!

1557 bytes copied in 0.476 secs (3271 bytes/sec)

HYD-1 #





## Verify backup IOS file on FTP server

Verify the IOS file on FTP server.



## Backup of Router Configuration on SCP Server

HYD-1 # copy startup-config scp:

Address or name of remote host []? **192.168.202.10**

Destination username [HYD-1]? **cisco**

Destination filename [HYD-config]? **HYD-SCP**

Writing HYD-SCP

Password: **ccna**

!!

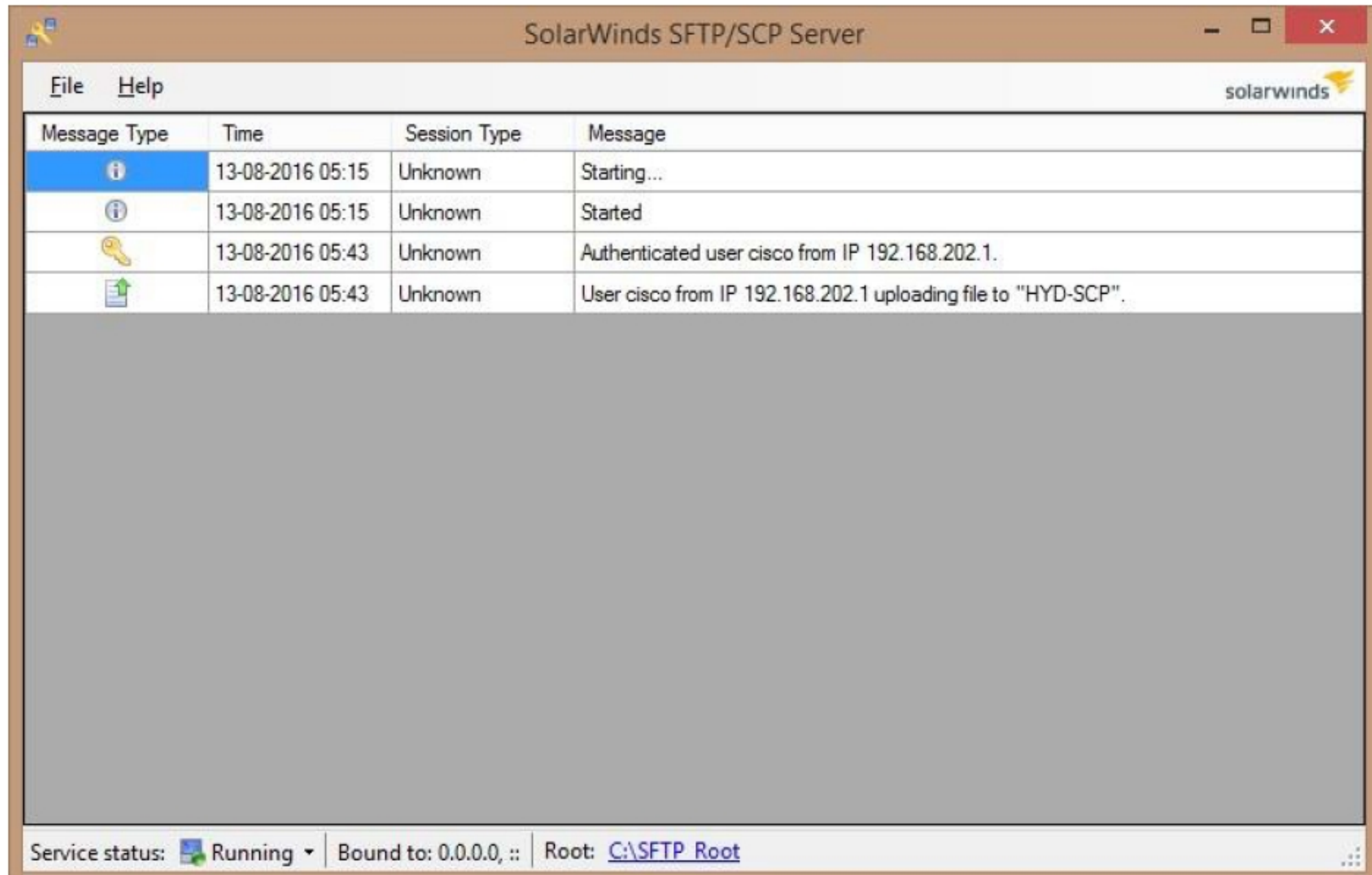
1557 bytes copied in 0.476 secs (3271 bytes/sec)

HYD-1 #



## Verify backup configuration file on SCP Server

Verify the Configuration file on SCP server, default path is **C:\SFTP\_Root**.



## Backup of Router IOS

HYD-1 # **show flash**

System flash directory:

File Length Name/status

1 63139972 Aug 01 2016 14:13:20 c2800nm-adventerprisek9-mz.151-1.T.bin

856064 bytes available (63156224 bytes used)

HYD-1 #

HYD-1 # **copy flash scp:**

Source filename []? **C2800NM-ADVENTERPRISEK9-MZ.151-1.T.BIN**

Address or name of remote host []? **192.168.202.10**

Destination username [HYD-1]? **cisco**

Destination filename [C2800NM-ADVENTERPRISEK9-MZ.151-1.T.BIN]?

Writing C2800NM-ADVENTERPRISEK9-MZ.151-1.T.BIN

Password: **ccna**

!!  
 !!!  
 !!!  
 !!!

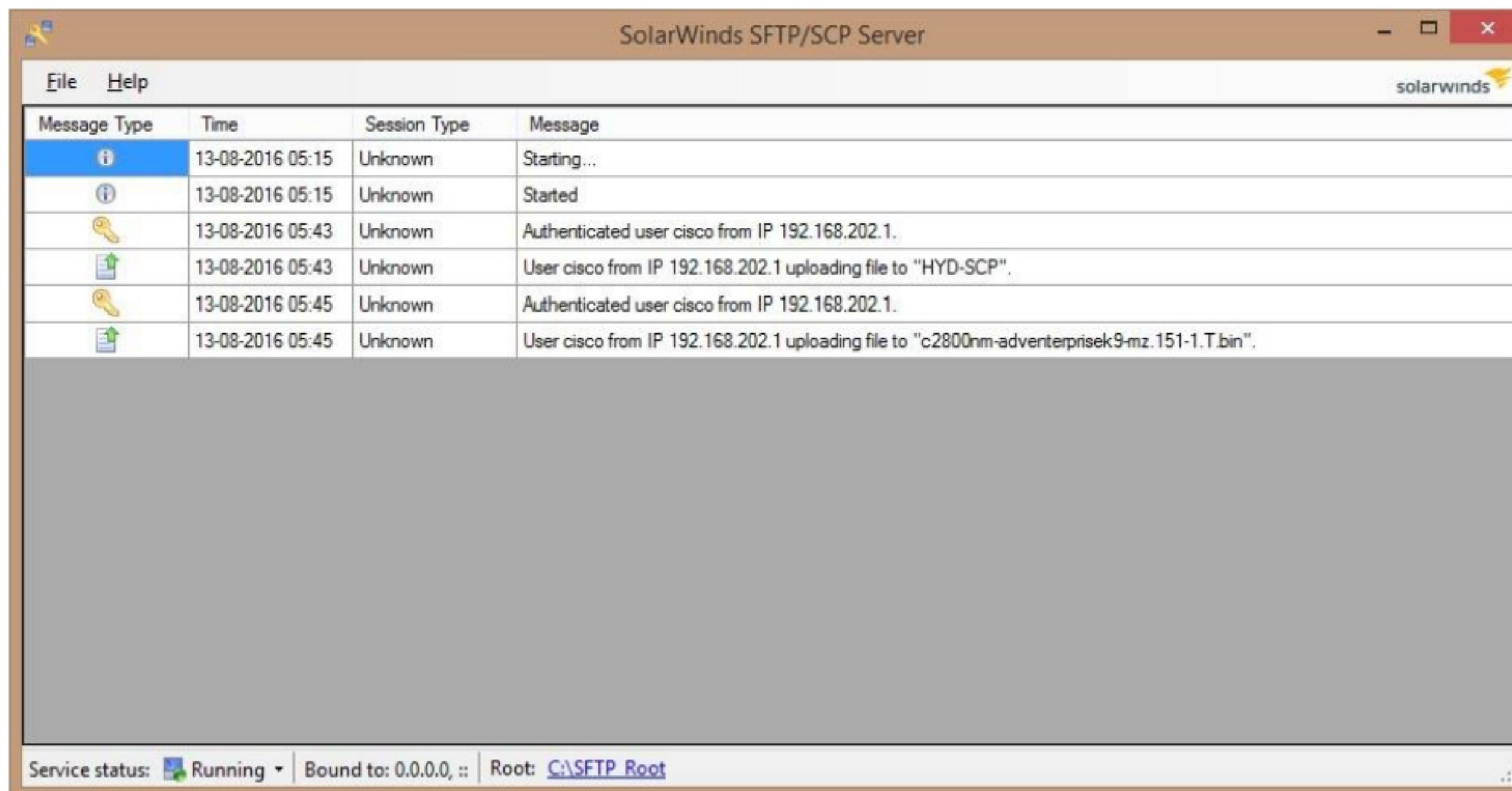
63139972 bytes copied in 264.584 secs (238639 bytes/sec)

HYD-1 #



## Verify backup IOS file on FTP server

Verify the IOS on SCP server, default path is **C:\SFTP\_Root**.



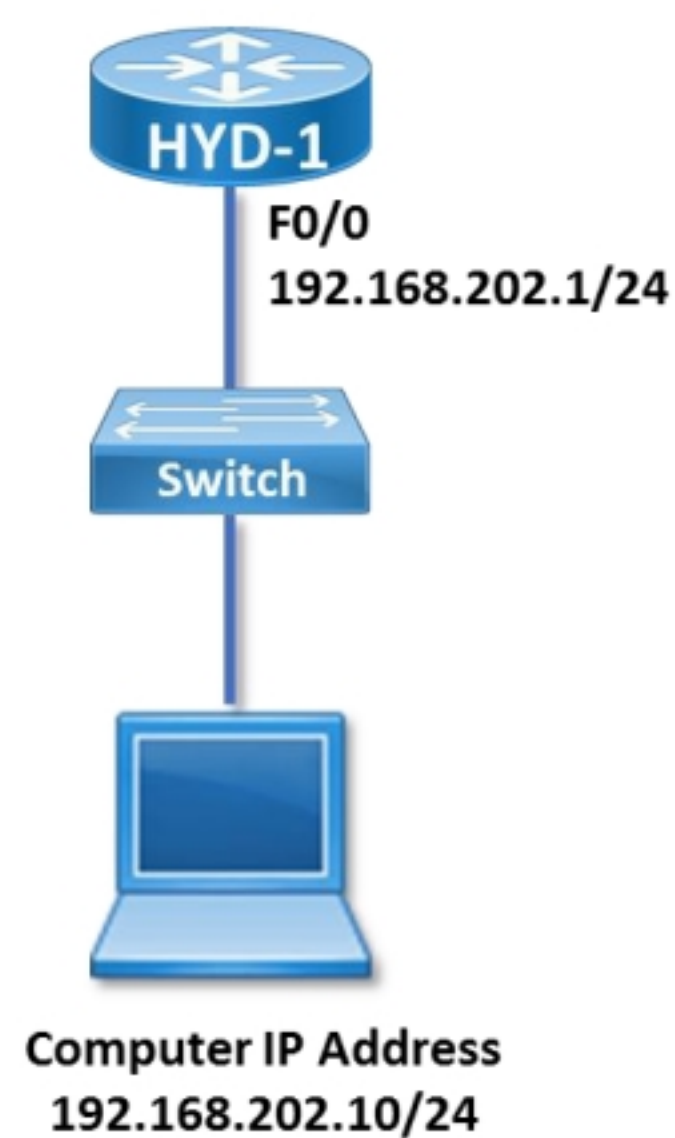
## LAB 49: IOS Licensing

### OBJECTIVE:

To understand and install Cisco IOS license on router

### TOPOLOGY:

Setup Ethernet connectivity for the lab as below:



**Pre-requisite:** 192.168.202.10 computer should have TFTP server software installed and running.

### TASK:

- Verify Cisco IOS License
- Install License on Cisco Router





## CHALLENGE LAB

### NAT – QUESTION

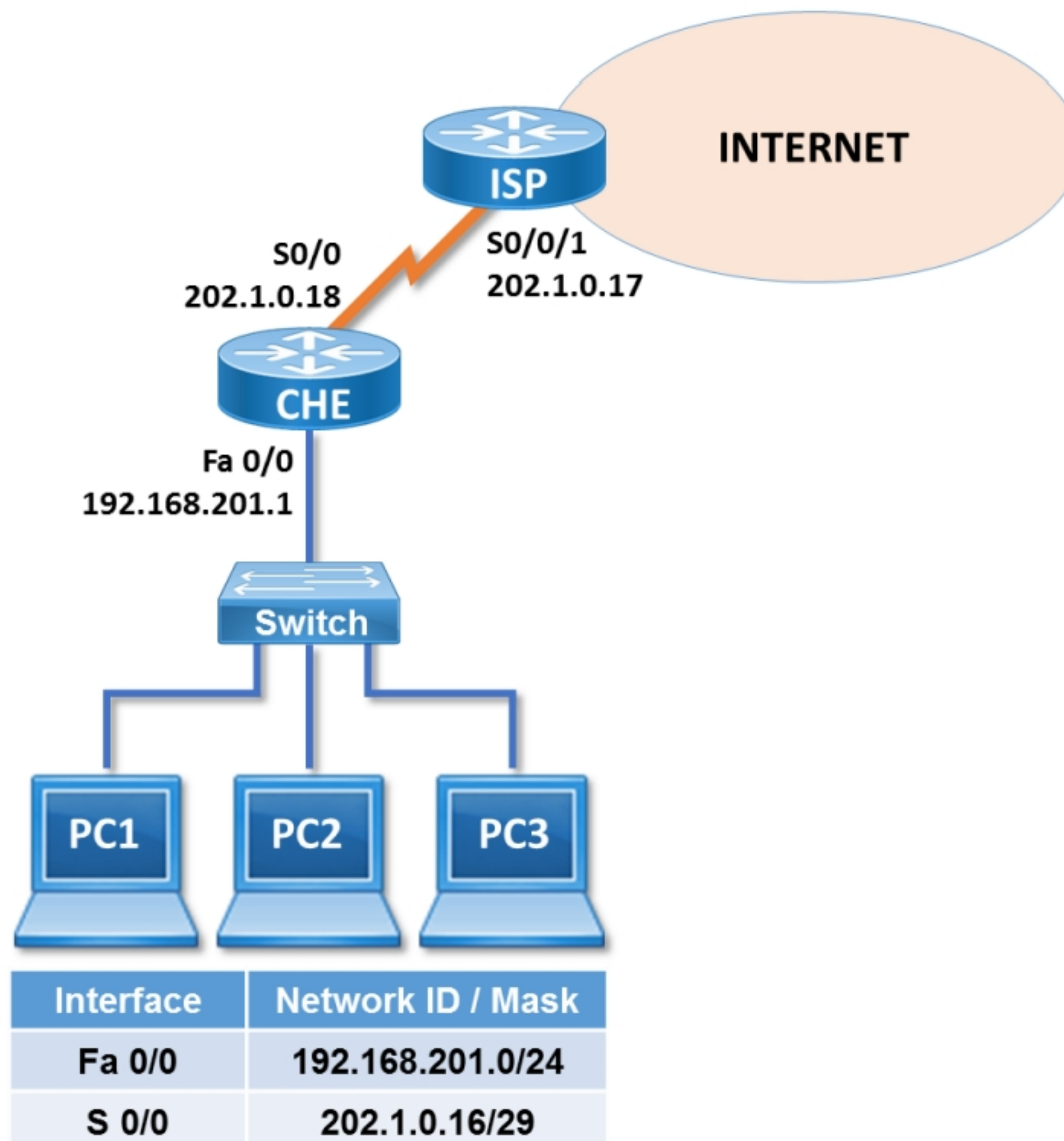
A network associate is configuring a router for the XYZ company to provide internet access. The ISP has provided the company 4 public IP addresses from 202.1.0.19 to 202.1.0.22. The company has 14 hosts that need to access the internet simultaneously. The hosts in the company LAN have been assigned private space addresses in the range of 192.168.201.17 – 192.168.201.30.

The following has already been configured on the router :

- The basic router configuration
- The appropriate interfaces have been configured for NAT inside and NAT outside
- The appropriate static routes have also been configured
- All passwords have been temporarily set to “cisco”

### Topology:

Connectivity and IP address for the lab are as below:





## NAT – SOLUTION

### Verify Existing CHE Configuration

CHE # **show running-config**

Using 791 bytes

!

version 15.1

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

!

hostname CHE

!

enable password cisco

!

interface FastEthernet0/0

ip address 192.168.201.1 255.255.255.0

ip nat inside

duplex auto

speed auto

!

!

interface Serial0/0/0

ip address 202.1.0.18 255.255.255.248

ip nat outside

!

ip route 0.0.0.0 0.0.0.0 Serial0/0/0

!

line con 0

!

line aux 0

!

line vty 0 4

password zoom

login

!

!

!

end

The XYZ company has 14 hosts that need to access the internet simultaneously but we just have 4 public IP addresses from 202.1.0.19 to 202.1.0.22/29. So we need to configure NAT overload (or PAT).

**Create a NAT pool of global addresses to be allocated with their netmask. i.e. /29 = 255.255.255.248**

```
CHE (config) # ip nat pool mypool 202.1.0.19 202.1.0.22 netmask 255.255.255.248
```

**Create a standard access control list that permits the addresses that are to be translated**

```
CHE (config) # access-list 1 permit 192.168.201.16 0.0.0.15
```

**Establish dynamic source translation, specifying the access list that was defined in the prior step**

```
CHE (config) # ip nat inside source list 1 pool mypool overload
```

This command translates all source addresses that match the **access list 1** i.e. source address from **192.168.201.17 to 192.168.201.30**, into an address from the pool named **mypool** i.e. the pool of ip addresses from **202.1.0.19 to 202.1.0.122**. **Overload** keyword allows mapping multiple IP addresses to a single registered IP address (many-to-one) by using different ports

**Verify NAT inside and NAT outside statements are configured on correct interfaces.**

```
CHE (config)# interface F0/0
CHE (config-if)# ip nat inside
CHE (config-if)# exit
CHE (config)# interface S0/0
CHE (config-if)# ip nat outside
CHE (config-if)# exit
```

**Save the configuration using below command**

```
CHE# copy running-config startup-config
```

**Verify configuration from a Computer:**

```
ping 202.1.0.17
```

The ping should work and you should get reply packets.



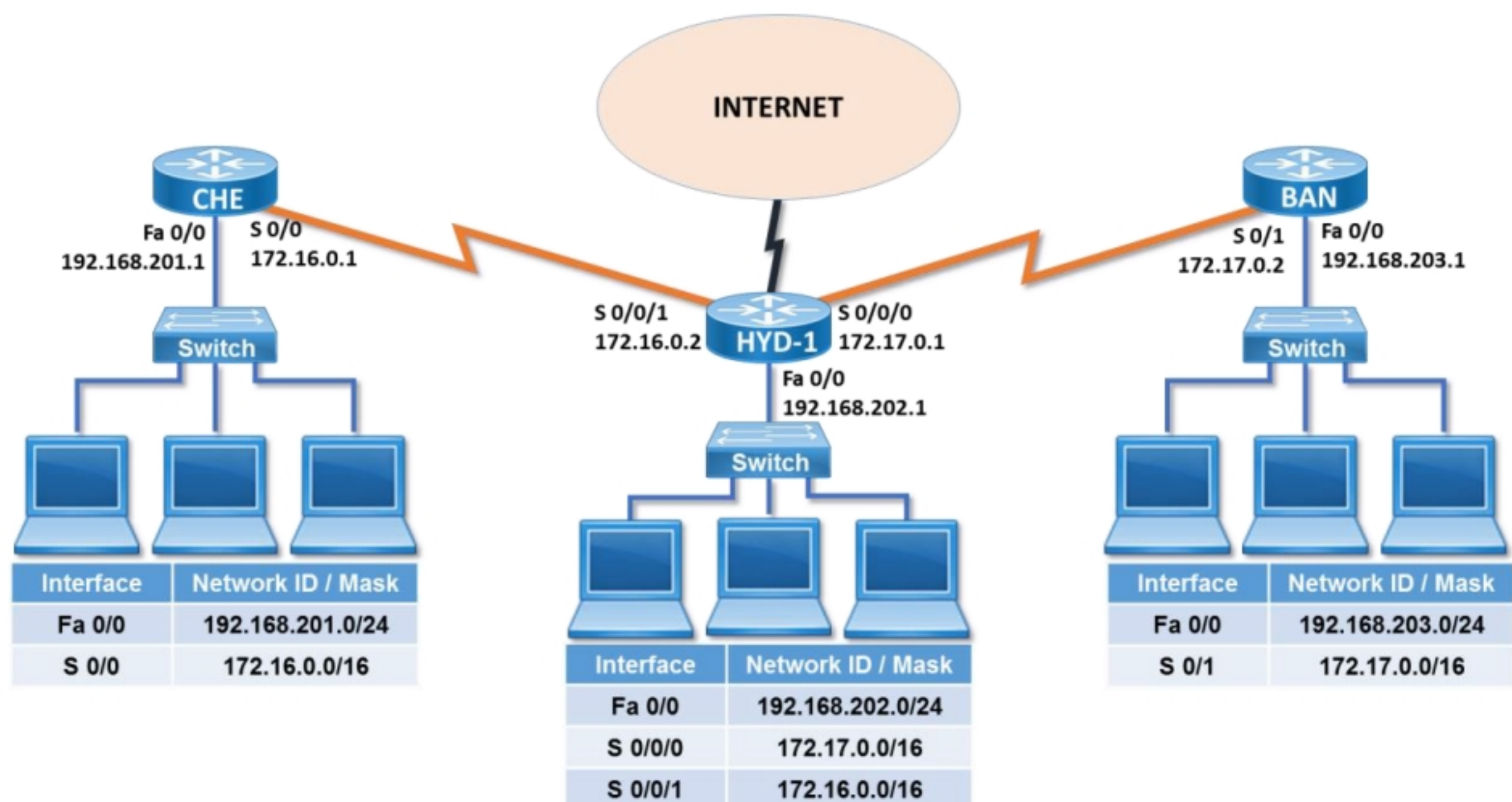
## EIGRP – QUESTION

After adding BAN router, no routing updates are being exchanged between HYD-1 and the new location. All other inter connectivity and Internet access for the existing locations of the company are working properly.

The task is to identify the fault(s) and correct the router configuration to provide full connectivity between the routers. All passwords on all routers are “cisco”

### Topology:

Connectivity and IP address for the lab are as below :



## EIGRP – SOLUTION

### Verify Existing CHE Configuration

CHE # **show running-config**

CHE#sh running-config  
Building configuration...

Current configuration : 837 bytes  
!  
version 15.1  
no service timestamps log datetime msec  
no service timestamps debug datetime msec  
no service password-encryption  
!  
hostname CHE  
!  
<output omitted>  
!  
interface FastEthernet0/0  
ip address 192.168.201.1 255.255.255.0  
duplex auto  
speed auto  
!  
interface Serial0  
ip address 172.16.0.1 255.255.0.0  
clock rate 64000  
!  
router eigrp 10  
network 172.16.0.0  
network 192.168.201.0  
no auto-summary  
!  
<output omitted>  
!  
!  
end

### Verify Existing HYD-1 Configuration

HYD-1 # **sh running-config**

Building configuration...

Current configuration : 868 bytes  
!  
version 15.1  
no service timestamps log datetime msec  
no service timestamps debug datetime msec  
no service password-encryption  
!  
hostname HYD-1



```
!  
<output omitted>  
!  
!  
interface FastEthernet0/0  
ip address 192.168.202.1 255.255.255.0  
duplex auto  
speed auto  
!  
interface Serial0/0/0  
ip address 172.16.0.2 255.255.0.0  
!  
interface Serial0/0/1  
ip address 172.17.0.1 255.255.0.0  
clock rate 64000  
!  
router eigrp 10  
passive-interface Serial0/0/1  
network 192.168.202.0  
network 172.16.0.0  
no auto-summary  
!  
<output omitted>  
!  
end
```

### **Verify Existing BAN Configuration**

```
BAN # sh running-config  
Building configuration...
```

```
Current configuration: 819 bytes  
!  
version 15.1  
no service timestamps log datetime msec  
no service timestamps debug datetime msec  
no service password-encryption  
!  
!  
hostname BAN  
!  
<output omitted>  
!  
interface FastEthernet0/0  
ip address 192.168.203.1 255.255.255.0  
duplex auto  
speed auto  
!  
interface Serial0/0/0  
ip address 172.17.0.2 255.255.0.0  
!  
!
```

```
router eigrp 11
 network 192.168.203.0
 network 172.17.0.0
 no auto-summary
!
ip classless
!
<output omitted>
!
end
```

From the above outputs, we now know that router **BAN** is wrongly configured with an **AS No. 11** and all other routers are configured with **AS No. 10**. Whenever the AS numbers among routers are mismatched, no adjacency is formed.

**To resolve this issue, simply re-configure EIGRP commands on router BAN :**

```
BAN >enable
BAN # configure terminal
BAN (config)# no router eigrp 11
BAN (config)#router eigrp 10
BAN (config-router)# network 192.168.203.0
BAN (config-router)# network 172.17.0.0
BAN (config-router)# no auto-summary
BAN (config-router)# end
```

**Save the configuration using the command below**

```
BAN# copy running-config startup-config
```

From the HYD-1 output, we had found out 2 issues

- All networks on HYD-1 are not advertised in EIGRP configuration.
- passive-interface command given for the interface connected to BAN router

**Advertise Missing Networks in EIGRP Configuration**

```
HYD-1 >enable
HYD-1 # configure terminal
HYD-1 (config)# router eigrp 10
HYD-1 (config-router)# network 172.17.0.0
HYD-1 (config-router) # end
```

**Disable Passive Interface command for interface connected to BAN router**

```
HYD-1 (config) # router eigrp 10
HYD-1 (config-router) # no passive-interface serial 0/0/1
HYD-1 (config-router) # end
```



Save the configuration using below command

HYD-1 # **copy running-config startup-config**

Check the routing table on BAN. You should now be able to see all the routes.



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**Duration: 3 Months  
4 Hrs Per Day**

**100%**

**GUARANTEED**

**JOB**

ASSISTANCE

~~Fees: ₹ 10,000/-~~

Introductory Special Offer

**Fees: ₹ 5,500/-**

+ 15% Service Tax

~~Fees: ₹ 25,000/-~~

Introductory Special Offer

**Fees: ₹ 9,999/-**

+ 15% Service Tax



## MICROSOFT EXCHANGE SERVER-2013

**Duration: 2 Weeks | 4 Hrs Per Day** (starts on 15<sup>th</sup> & 30<sup>th</sup> of every month)

**Batches:** (Contact the Counselors for the next available batch)

**Fees: ₹ 2,500/-**  
+ 15% Service Tax

## MICROSOFT PRIVATE CLOUD

Microsoft Certified Solutions Expert [MCSE] Private Cloud

**Duration: 2 Weeks | 4 Hrs Per Day**

**Batches:** (Contact the Counselors for the next available batch)

**Fees: 2,500/-**  
+ 15% Service Tax

## ADVANCED LINUX

**Duration: 2 Weeks | 4 Hrs Per Day** (starts on 15<sup>th</sup> & 30<sup>th</sup> of every month)

**Batches:** (Contact the Counselors for the next available batch)

**Fees: ₹ 2,500/-**  
+ 15% Service Tax

## CCNA SECURITY

(Pre requisite is CCNA R&S)

CISCO CERTIFIED NETWORK ASSOCIATE - SECURITY

**Duration: 2 Weeks | 4 Hrs Per Day** (starts on 15<sup>th</sup> of every month)

**Batches:** Morning: 7.30 or Evening: 6.00

**Fees: ₹ 7,500/-**  
+ 15% Service Tax

## CCNP SECURITY

(Pre requisite is CCNA Security at ZOOM)

CISCO CERTIFIED NETWORK PROFESSIONAL - SECURITY

**Duration: 2 Weeks | 4 Hrs Per Day** (starts on 30<sup>th</sup> of every month)

**Batches:** Morning: 7.30 or Evening: 6.00

**Fees: ₹ 9,500/-**  
+ 15% Service Tax

## CCIE SECURITY

(Pre requisite is CCNA & CCNP Security at ZOOM)

CISCO CERTIFIED INTERNETWORK - SECURITY

**Duration: 1 Month | 4 Hrs Per Day**

**Batches:** (Contact the Counselors for the next available batch)

**Fees: ₹15,500/-**  
+ 15% Service Tax

## VMware vSphere

(Pre requisite is MCSE)

**Duration: 1 Month | 4 Hrs Per Day** (starts on 15<sup>th</sup> of every month)

**Batches:** Morning: 7.30 and Evening: 7.30

**Fees: ₹ 4,950/-**  
+ 15% Service Tax

## VMware vCloud

(Pre requisite is VMware vSphere)

**Duration: 1 Week | 4 Hrs Per Day** (starts on 15<sup>th</sup> of every month)

**Batches:** Morning: 9.30 to 11.30

**Fees: ₹ 2,500/-**  
+ 15% Service Tax

## CHECKPOINT FIREWALL

**Duration: 2 Weeks | 4 Hrs Per Day**

**Batches:** (Contact the Counselors for the next available batch)

**Fees: ₹ 5,500/-**  
+ 15% Service Tax

**We also offer the following courses** (Contact the Counselors for the next available batch)

- › **CCNA Voice** @ ₹7,500/-
- › **CCNP Voice** @ ₹9,500/-
- › **CCIE Collaboration** @ ₹15,500/-

- › **CCNA Data Center** @ ₹7,500/-
- › **CCNP Data Center** @ ₹9,500/-
- › **CCIE Data Center** @ ₹15,500/-

› **IPv6 Migration** @ ₹5,500/-

## FACULTY

- › All Senior Engineers of Zoom working on Live projects
- › Training Engineers of British Army, CISCO, CMC, GE, BSNL, Tata Teleservices and Several Corporates etc for 18 Years.



# FREE Training

Zoom Technologies offers a number of free resources for the professional development of network engineers.

Register on our website to get access to the video recordings of live sessions on:

- **MCSE – Windows Server 2012**
  - **Cisco – CCNA**
  - **Cisco – CCNP**
  - **Cisco – CCIE**
  - **Exchange Server 2013**
  - **Linux**
  - **Advanced Linux**
  - **Ethical Hacking and Countermeasure Expert ([www.us-council.com](http://www.us-council.com))**
- } All Tracks (R & S, Security and Voice)
- } All Flavors

Find us at: [www.zoomgroup.com](http://www.zoomgroup.com)

Like us on Facebook and get access to free online webinars as well as special offers and discounts.  
<https://www.facebook.com/ZoomTechnologies>

## Online Training

Online Training at Zoom is a cost effective method of learning new networking skills from the convenience of your home or workplace.

Taking an online training course has many advantages for everyone (Freshers / Working Professionals). Zoom offers online training for the highly coveted CCNA, CCNP and CCIE courses as well as MCSE, Linux, VMware, Ethical Hacking and Firewalls, IPv6 with more courses planned for the near future. These are live instructor led courses, using Cisco WebEX. Check out our online course offerings at: [http://zoomgroup.com/online\\_course](http://zoomgroup.com/online_course)

## Job Opportunities

There is a high demand for network and security professionals at all times. Apart from job opportunities in India and the Middle East, network and security administrators are also sought-after in the US and Europe.

If you do not have the right skills, then get them now! Choose the experts in network and security training, an organization which has already trained over one hundred thousand engineers.

For the latest job openings in networking and security, register and upload your resume on: <http://zoomgroup.com/careers> or visit zoom to choose job offering from several multinational companies.





## ABOUT US

**Zoom Technologies** India Pvt. Ltd. is a pioneering leader in network and security training, having trained over a hundred thousand engineers over the last two decades.

We offer a world class learning environment, with state-of-the-art labs which are fully equipped with high-end routers, firewalls, servers and switches. All our courses are hands-on so you'll get much needed practical experience.

The difference between us and the competition can be summed up in one simple sentence. Our instructors are real-time network professionals who also teach.

Zoom has designed, developed and provided network and security solutions as well as training to all the big names in the Indian industry, for the public sector as well as corporate leaders. Some of our clients are:

TATA  
BSNL  
VSNL  
Indian Railways  
National Police Academy  
Air Force Academy  
IPCL- Reliance Corporation  
CMC  
British Army

No other training institute can boast of a customer base like this. This is the reason for the resounding success of our networking courses. If you do not have the right skills, then get them now. Come, join the experts!

## Training Centers in Hyderabad, India.

### Banjara Hills

HDFC Bank Building, 2nd Floor,  
Road # 12, Banjara Hills,  
Hyderabad - 500 034  
Telangana,  
India.

Phone: +91 40 23394150  
Email: banjara@zoomgroup.com

### Ameerpet

# 203, 2nd Floor,  
HUDA Maitrivanam, Ameerpet,  
Hyderabad - 500 016  
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Phone: +91 40 23745252  
Email: ameerpet@zoomgroup.com

### Secunderabad

Navketan Building,  
5 Floor, # 501  
Secunderabad - 500 003  
Telangana,  
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Phone: +91 40 27802461  
Email: mktg@zoomgroup.com

### Dilsukhnagar

1st Floor, # 16-11-477/B/1&B/2,  
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Hyderabad - 500 060  
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